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# The effect of interactivity in an online course on behavior change and self-efficacy among health care professionals

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The Effect of Interactivity in an Online Course on Behavior Change and Self-Efficacy  
Among Health Care Professionals

Monica L. Blackwell

A thesis submitted to the Graduate Faculty of

JAMES MADISON UNIVERSITY

In

Partial Fulfillment of the Requirements

for the degree of

Master of Science in Education

Learning, Technology, and Leadership Education

May 2011

## **Dedication**

To my family and fiancé, without each of them I would not be where I am today. Thanks for always showing me that even the largest task can be done by taking it one step at a time, knowing that each of you are behind me each step of the way.

## **Acknowledgements**

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Finally, and most importantly, I would like to thank my family, fiancé, and friends. There are not enough pages to begin to thank you for all that you have done for me throughout the years! Thank you for putting up with me and supporting me emotionally and financially, throughout this grueling process. I would not have made it through each of my meltdowns without your love and support. Thank you for the encouragement, ice cream, and finding ways to make me smile throughout this process.

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## **Abstract**

Continuing Medical Education (CME) interventions continue to be an important factor in the lifelong learning of health care professionals. Online interventions have become increasingly popular since the inception of the Internet. Many CME courses (traditional and online) are evaluated solely on the knowledge gained and participant reactions. However, this study focused on the instructional design of an online CME course and how the design affected the self-efficacy of the learner and the amount of knowledge transferred to the professionals' practice. Specifically, this study answered the following research questions: 1) How can one design online instruction that will foster a change in health care professionals' behavior from the course and into medical practice? 2) How can one design online instruction that will increase health care professionals' self-efficacy with the presented content? The researcher designed two online CME courses regarding the clinical diagnosis of Lyme disease. One course incorporated very few interactive, instructional elements, while the second course incorporated audio, video, and interactive elements. The researcher collected data using both quantitative and qualitative methods via pre-tests, post-tests, a final survey given to participants three weeks after completing the online course, and four interviews. The findings indicated that the knowledge, self-efficacy, and behavior did improve for the majority of participants. However, interactive, instructional elements were not found to be the sole reason for the increase of knowledge, self-efficacy, and change in behavior. The present study did confirm that the instructional design of online courses was important. These results suggest that future CME designers should continue to

investigate elements within online courses to see which elements are found to be the most valuable for learners' gain in knowledge, self-efficacy, and a change in behavior.

*Keywords:* Online Continuing Medical Education, Interactivity, Self-efficacy, Behavioral Change

## **Chapter I. Introduction**

According to the Center for Disease Control (CDC), there has been a steady increase of Lyme disease cases throughout the United States (U.S.) for the past three years. In 2009, there were 29,959 reported cases of Lyme disease (Center for Disease Control, 2009). Berton (2009) reported that there has been a “71 percent increase [of Lyme disease cases] over the past two years.” (Berton, 2009, para. 3) These statistics do not include the number of cases that go unreported. Many U.S. citizens do not realize that “one CDC estimate put the true number of current Lyme disease cases at 300,000” (Berton, 2009, para 3). Young (1998) responds to this gap by calling for “better physician education about the criteria for diagnosis of Lyme disease” (p. 1629). Even though Young saw this issue as relevant and necessary in 1998, the prevalence of Lyme disease has continued to increase each year. One way to address this issue is to continue to educate all health care professionals (physicians, nurses, patients, etc.) on the seriousness of this disease (Young, 1998).

For many health care professionals, medical school is the final step in their formal education. One distinct feature of medical school is clerkships. In medical school, students are required to participate in a specific number of clerkship hours within selected medical disciplines. The amount of time required to spend in each medical setting varies. By utilizing these clerkships, students are exposed to a vast number of hands-on experiences. Once health care professionals have completed medical school, their learning continues through Continuing Medical Education (CME) interventions. In CME interventions, the learning is more self-directed using lectures, journals, and online

modules. These CME interventions are less experiential than the instruction used in medical school (Barzansky & Etzel, 2004, 2005, 2009, 2010).

As quoted in his article, *Global Health, Global Learning*, Davis (1998b) defines CME as “any and all the ways by which doctors learn after formal completion of their training” (p. 385). However, doctors are not the only health care professionals in need of continuing education. Continuing Medical Education (CME) has been an important professional development requirement for all health care professionals (including physicians, physician assistants, nurses, etc.) for a number of years. According to Moore, Green, and Gallis (2009), “most physicians believe that to provide the best possible care to their patients, they must commit to continuous learning” (p. 1). Levett-Jones (2005) discusses the importance for nurses to expand their knowledge on a regular basis in order to “remain cognizant of the latest research and developments in their field” (p. 229). As new medical discoveries and advances are established, it is important for all health care professionals to remain up-to-date on the new medical knowledge and skills in order to continue improving their practices. In order to remain current with these changes, a lifestyle of continuous learning is necessary for all health care professionals. One way health care professionals stay current with the advancing medical field is by participating in CME courses.

The history of CME can be dated back to the 1700’s and the Venetian government. It was during this period of time that medical practitioners were required to attend a specific number of lectures each year in order to continue practicing medicine. “The requirement that physicians, surgeons, and barber-surgeons attend two anatomy lectures or dissections yearly apparently functioned smoothly for several centuries” (Ell,

1984, p. 753). However, this requirement was abolished in 1801 due to a new reign of power. History has been repeated, as physicians presently are required to complete continuing medical education in order keep their medical licensure. One of the factors causing an interest for medical doctors to participate in CME activities is the “need for social accountability to ensure the competence of physicians and the health of the public” (Davis, Davis, & Bloch, 2008, p. 653). Due to the variances in state requirements, physicians are required to complete an average of anywhere from 12 to 50 hours of CME credit per year in order to maintain their medical license (American Medical Association, 2010).

Nursing education can be dated back to the 1800s with the rise of Florence Nightingale, as she became one of the first influential nurses. Nightingale assisted “in establishing the first modern basic nursing education programs” (Stein, 1998, Nursing Early Years, para. 4). As the nursing field slowly progressed, nursing education took the shape of short courses that hospitals provided to the nurses at no cost. In the 1950’s, nursing education became more prominent, nursing journals were established, and nursing research emerged. The 1970’s brought an influx of money and support for the continuing education of nurses and other health care practitioners (Stein, 1998). After a number of years of change and reconstruction within the medical fields, CME has now become a major part of all health care professionals’ continuing education.

According to the Accreditation Council for Continuing Medical Education (ACCME) there were over 760,000 hours of instruction and over 100,000 activities offered in 2008. As the years progress, the number of CME activities and courses continue to increase and health care professionals are provided a wide range of credit

possibilities (ACCME Annual Report Data 2008). The traditional format for CME has been “the formal course, conference, symposium, or workshop” (Davis et al., 2008, p. 652). These formats have been the “staple” CME components. However, with the ever-changing medical environment there have been a few changes to the delivery methods, as well. One major addition to the traditional CME format was the introduction of computers and the Internet (Davis et al., 2008).

The Internet has become vastly important for medical practitioners, both for research and as a tool for professional development (Curran & Fleet, 2005). Nearly 10 years ago, Casebeer, Bennett, Kristofco, Carillo, and Center (2002) conducted a survey to determine physicians’ Internet usage and the methods used to seek out current medical information. At that time, 80% of survey participants reported using the Internet to seek out medical information. The survey also reported that 8% used the Internet daily, “21% several times a week, 25% weekly, 28% monthly, and 18% rarely” in order to find current medical information (Casebeer et al., 2002, pp. 36-37).

For continuing medical education purposes, 31% of the Internet usage was for educational classes (Casebeer et al., 2002). The ACCME reported that 30% of all activities provided by ACCME Accredited Providers in 2008 were various types of online CME activities (ACCME Annual Report Data 2008). According to *cmelist.com*, there were over 300 different websites offering online CME courses as of July 2009 (Sklar, 2009). With the increased availability and popularity of the Internet, online CME courses have become less expensive and more convenient, flexible, and timely (Bergeron, 2006; Casebeer et al., 2003; Curran, Fleet, & Kirby, 2010; Horton, 2000; Sargeant et al., 2004; Wutoh, Boren, & Balas, 2004). With a disease such as Lyme disease, which



continues to spread each year, online CME courses could be one distribution method that would reach a large number of professionals in a cost effective, timely, and convenient manner. Online CME “allows physicians to obtain CME from regional, national, and international experts without needing to travel” (Peterson, Galvin, Dayton, & D’Allesandro, 1999, p. 1434).

### **Problem Statement**

Each year the number of online CME courses is increasing. There is great variability in the quality of instructional design, and media chosen for instructional delivery. Some courses are delivered through podcasts and/or videos, while others are simply composed of slides with informative text (Davis et al., 2008). Sargeant et al. (2004) describe online CME programs in three different categories: “content presentation (e.g., text only, audio lectures with slides, text with multimedia materials), interaction with content (e.g., cases with questions, quizzes), and interpersonal interaction (e.g., on-line courseware, Listserv, electronic mail, desktop videoconference)” (p. 228). With the vast number of online CME activities, which instructional components enable the greatest gain in knowledge which in turn would increase a learner’s self-efficacy? Which components allow for the greatest amount of knowledge transfer to health care professionals’ practice?

“Transfer of learning is widely considered to be a fundamental goal of education” (Marini & Genreux, 1995, p.1). Teachers hope that the methods used in the classroom will be effective so that students will apply the new knowledge outside the classroom in real-life situations. This same concept of knowledge transfer is the goal of educational activities, especially in the medical field. However, how do researchers know if the

instructional methods are actually contributing to health care professionals' competence? Does the instruction foster the transfer of knowledge to the professionals' practices or work places, or does it increase self-efficacy further than the knowledge test at the end of the course? "CME has moved away from simple learning objectives" (Davis et al., 2008, p. 655). CME courses should now focus on "what the learner should be expected to do differently as a result of what has been learned" (Davis et al., 2008, p. 655).

Current CME courses focus more on disseminating information, but information dissemination does not always result in improved skills. This lack of improvement is especially true if the current CME does not cover the decision making process in diagnosing and treating patients (Cantillon & Jones, 1999; Casebeer et al., 2004; Curran & Fleet, 2005; Davis, 1998a; Mansouri & Lockyer, 2007; Wutoh, et al., 2004). In the past, studies have evaluated the knowledge gains obtained by health care professionals when completing a CME course (all formats) (Cobb, 2004; Curran et al., 2010; Kemper et al., 2002). Davis, O'Brien, Freemantle, Wolf, Mazmanian, and Taylor-Vaisey (1999) evaluated CME methods and stated that "knowledge is clearly necessary but not in and of itself sufficient to bring about change in physician behavior" (p. 873). These evaluations lack proof of whether the information gained during a CME course was 1) being transferred to the health care professional's practice, and 2) actually improving his/her practice.

### **Research Question**

With the multitude of studies that have been conducted on the effectiveness of CME (Cantillon & Jones, 1999; Casebeer et al., 2004; Cook, Levinson, Garside, Dupras, Erwin, & Montori, 2008; Davis, 1998a; Francke, Garssen, & Abu-Saad, 1995;

Mazmanian & Davis, 2002) the question of knowledge transfer still remains. This study addressed some of the issues revolving around the elements of instructional design within online CME activities. Specifically, it sought to answer the following research questions:

1. How can one design online instruction that will promote the transfer of newly acquired skills from the course to the medical practice?
2. How can one design online instruction that will increase health care professionals' self-efficacy with the presented content?

### **Hypothesis**

In the AMEE Education guide by Davis et al. (2008), the authors state that “effectiveness is improved by increasing interactivity and relevance using appropriate lecture delivery methods and case based material” (p. 656). When discussing web based materials, the authors state, “just like live education, these [web] activities must be interactive in order to engage the learner and improve impact” (p. 657). The researcher hypothesized that health care professionals would have a deeper understanding of the presented content after completing the proposed online CME course that included interactive elements. This deeper understanding would likely lead the health care professional to have a higher self-efficacy, and result in the transfer of newly gained knowledge to his/her practice.

### **Study Overview**

Studies have been conducted involving the interactive component of online course material. The majority of these studies have evaluated user satisfaction and the amount of knowledge gained from the course (Curran & Fleet, 2005; Curran et al., 2010; Evans & Gibbons, 2007; Kemper et al., 2002; Lipman, Sade, Glotzbach, Lancaster, & Marshall,

2001; Mazzoleni et al., 2009). Few studies, if any, have examined the impact of CME on the practitioners' self – efficacy or change in behavior after completing the CME, in order to fill this gap in the literature. The present study assessed the health care professional's 1) level of confidence in diagnosing and treating a disease, and 2) their resulting change in behavior. These two components were assessed using survey questions that were based on the objectives in the training. The study focused on incorporating “interaction with content and interpersonal interaction” (Sargeant et al., 2004, p. 228). The researcher designed an online module that included text, audio, video, and most importantly, interactive elements. Throughout the course, participants were exposed to new information and were then asked to apply the new knowledge to complete the interactive questions and activities.

The current study compared three variables. The independent variable was the interactive elements included in the online CME course. The dependent variables were the degree of behavioral change and level of confidence among the participants. The current study entailed analyzing the effects of interactivity within an online CME course and how the interactive elements helped to increase self-efficacy and foster knowledge retention and transfer to the health care professional's workplace. To effectively execute the study, the research took place in two phases and the participants were divided into a control and an experimental group. During Phase I, all participants began by completing a pre-test concerning their knowledge of Lyme disease. Upon completion, they participated in an online CME course covering the topics of Lyme disease. The course included information about the symptoms, diagnosis, and other general information regarding the effects of the disease.

The experimental group received the online training course, which incorporated the interactive material, consisting of interactive questions on the new content material. These questions were placed throughout the learning module, causing the practitioner to interact and reflect on the content being presented. The experimental group also was asked to participate in an online discussion supported by the software, Wikispaces<sup>®</sup>, which allowed participants to create an alias to discuss video cases with other participants in the study. The control group's course material included case studies without the interactive elements of learning questions or the discussion board.

At the completion of the online CME course, all participants were tested again using a post-test. The pre- and post-tests allowed the researcher to ascertain the amount of knowledge gained by completing the online course. The post-test was the final process of Phase I.

Phase II took place three weeks after the participants had completed the online CME course and post-test. During this phase, the health care professionals participated in an online survey that questioned whether they utilized the new information and altered their behaviors (listed in the course objectives) in their everyday medical practice. The survey also questioned the participants about their level of confidence on the Lyme disease topics covered within the course material. This survey assessed the two dependent variables: the level of behavioral change and the level of confidence (self-efficacy) portrayed by the participants after a time lapse between the CME course and the survey.

Phase II also consisted of qualitative data collection via interviews with four participants. The interview questions were taken directly from those used in the survey.

However, by using an open-ended format, participants were able to expand upon their survey responses, thus providing a richer description of their experiences than afforded by the opinion scale survey questions.

### **Definition of Terms**

In order to address the research questions, there were several important key terms that needed to be defined. Table 1 presents these terms and how they were addressed throughout the research process.

Table 1.1

#### *Definition of Key Terms*

<b>Key Term</b>	<b>Definitions</b>
Continuing Medical Education (CME)	<ul style="list-style-type: none"> <li>➤ “Any attempt to persuade physicians to modify their practice performance by communicating clinical information” (Davis, 1998a, p. 22).</li> <li>➤ Davis also described CME as “any and all the ways by which doctors learn after formal completion of their training” (Davis &amp; Fox, 1994, p. 331).</li> <li>➤ Cantillon and Jones (1999) referred to CME as “all postgraduate educational events” (p. 1276) for their research article.</li> <li>➤ Almquist, Stein, Weiner, and Linn (1981) referred to Continuing Education for nurses as “all efforts (other than orientation) to maintain and improve clinical capabilities (p. 118).</li> <li>➤ The American Medical Association defined CME as consisting “of educational activities which serve to maintain, develop, or increase the knowledge, skills, and professional performance and relationships that a physician uses to provide services for patients, the public, or the profession” (Policy H-300.988).</li> </ul> <p>For the purpose of this study, the researcher used the American Medical Association’s definition as it makes reference to the importance of not only the knowledge gain but also a change in performance.</p>

Interactive Elements	<ul style="list-style-type: none"> <li>➤ Mayer and Chandler (2001) utilized the term “simple user interaction in a multimedia explanation” and defined the term as “user control over the words and pictures that are presented in the multimedia explanation” (p. 390).</li> <li>➤ Evans and Sabry (2003) discussed interactivity using a three-way model. This model stated that “an interaction is taken to involve a sequence of three actions: initiation, response, and feedback” (p. 90).</li> <li>➤ Evans and Gibbons (2007) used the following statement to determine interactivity: “A computer-based learning system is said to be interactive if it uses computer-initiated interactivity as an intrinsic part of the lesson” (p. 1149).</li> <li>➤ Kalyuga (2007) described interactive environments according to “their responsiveness to learners’ actions” (p. 392). The author divided the level of responsiveness into four levels: the “feedback level” which “is associated with providing a predefined feedback on specific learner’s actions, the “manipulation level” which “involves real-time online change or transformation of information in response to learners’ actions,” the “adaption level involves responses that are tailored to the learner’s previous behavior,” and the final “communication level is represented by dynamic online learning environments that involve flexible, non-predetermined iteratively-adapted responses to learners’ live queries” (p. 392-393).</li> </ul> <p>For the purpose of this study, the researcher utilized examples from the feedback, manipulation, and communication levels presented in Kalyuga’s study. These interactive elements included quizzes, the clicking-and-dragging technique, interactive case studies in which participants utilized other participant knowledge to discuss a case study, as well as other instructional methods.</p>
Self-efficacy	<ul style="list-style-type: none"> <li>➤ Bandura (1995) defined self-efficacy as the “beliefs in one’s capabilities to organize and execute the courses of action required to manage perspective situations” (p. 2).</li> <li>➤ Other studies (Harris, Salasche, &amp; Harris, 2001) have tested for an increase in self-efficacy but have utilized the term “level of confidence.”</li> </ul> <p>This study used the definition provided by Bandura. However,</p>

Self-efficacy (Continued)	throughout the study the researcher also referred to self-efficacy as “level of confidence” as seen in the definition of Harris et al. (2001).
Transfer of Knowledge	<ul style="list-style-type: none"> <li>➤ Hansen (2008) used the term knowledge transfer to investigate whether participants are “applying what they have learned under cognitive circumstances to a real-world situation” (p. 96).</li> <li>➤ Graham et al. (2006) used the term “knowledge-to-action or KTA” (p. 14) to describe the process of knowledge transfer.</li> </ul> <p>For the purpose of this study, the researcher defined “transfer of knowledge” using a combination of Hansen (2008) and Graham, et al. (2006) definitions. Throughout this study, “transfer of knowledge” referred to the health care professional utilizing the new information gained during the online CME course and changing his/her behavior in his/her medical practice.</p>

### Scope of Study and Assumptions

The scope of this research project included health care professionals (physicians, physician assistants, nurses, nurse practitioner, etc.) throughout the United States; however the majority of participants were located in the mid-Atlantic region and in Michigan. The researcher recruited participants using contacts made from the International Lyme and Associated Diseases Society (ILADS), local physicians in the Shenandoah Valley, and James Madison University (JMU) Health Sciences faculty. To expand the participant population, the researcher also included medical and nursing students who had previously/currently had experiences with patient care. Each health care professional participated on a voluntary basis and from a variety of positions in the medical field.



The researcher made several assumptions about the population used in the study. The first assumption involved the use of technology. The researcher assumed that all participants had a basic knowledge of the computer and were capable of navigating the Internet to access and engage in the course. In the experimental group, the researcher assumed that participants had a basic understanding of a discussion board platform. The researcher provided instructions, but assumed participants had some type of previous discussion board or blog experience.

Another assumption involved the amount of previous knowledge participants had regarding the topic of Lyme disease. The researcher assumed that they had some knowledge of Lyme disease. However, it was possible that the participant had little knowledge of Lyme disease, or had more than enough knowledge of Lyme disease and became disinterested.

### **Significance of the Study**

In any given year, the number of unreported cases of Lyme disease greatly exceeds the number of reported cases (Center for Disease Control, 2010). However, Lyme disease is not the only disease that is often unreported. The CDC also lists other diseases that have the potential to be unreported, which they refer to as notifiable infectious diseases. These identified diseases are labeled in this manner due to the “regular, frequent, and timely information regarding individual cases [that] is considered necessary for the prevention and control of the disease” (Center for Disease Control, 2010, p.2).

Each year there are almost 30,000 reported cases of Lyme disease within the United States. This data does not take into account the cases that are left unreported

(Center for Disease Control, 2009). Health care professionals need to become more aware of Lyme disease, its myriad symptoms, and how to diagnose the disease in a clinical setting. One way to increase awareness is to educate more health care professionals to help them understand and develop their understanding of Lyme disease. This study aimed to further educate health care professionals on the topic of Lyme disease. However, the design methods used in this study could also be generalized to other notifiable infectious diseases in order to educate health care professionals of other diseases that are often underreported.

Online courses are becoming very popular especially in the medical field due to the lack of time allotted for professional development during work hours. Online learning is convenient, flexible, cheap, and timely (Bergeron, 2006; Casebeer et al., 2003; Curran et al., 2010; Horton, 2000; Sargeant et al., 2004; Wutoh et al., 2004). However, little research has been conducted comparing online CME interventions and the possible change in the behavior of health care professionals.

This study added to the small body of research and attempted to influence the design of future online CME courses. This study not only evaluated the level of knowledge gained, but also evaluated whether health care professionals experienced a higher self-efficacy with the content knowledge and used the new information after completing the course. The current study examined whether the interactive elements included in the online course helped health care professionals retain and transfer information to the job, and whether these interactive elements improved their self-efficacy for the course material they learned. If CME instructional designers can show how the instructional design elements can cause a change in health care professional

behavior, it will inspire other CME course designers to incorporate interactive instructional design elements within online CME. By adding to this body of research, online instruction will continue to improve and will inspire others to continue to evaluate the effectiveness of online CME interventions as a whole.

### **Organization of the Remainder of the Study**

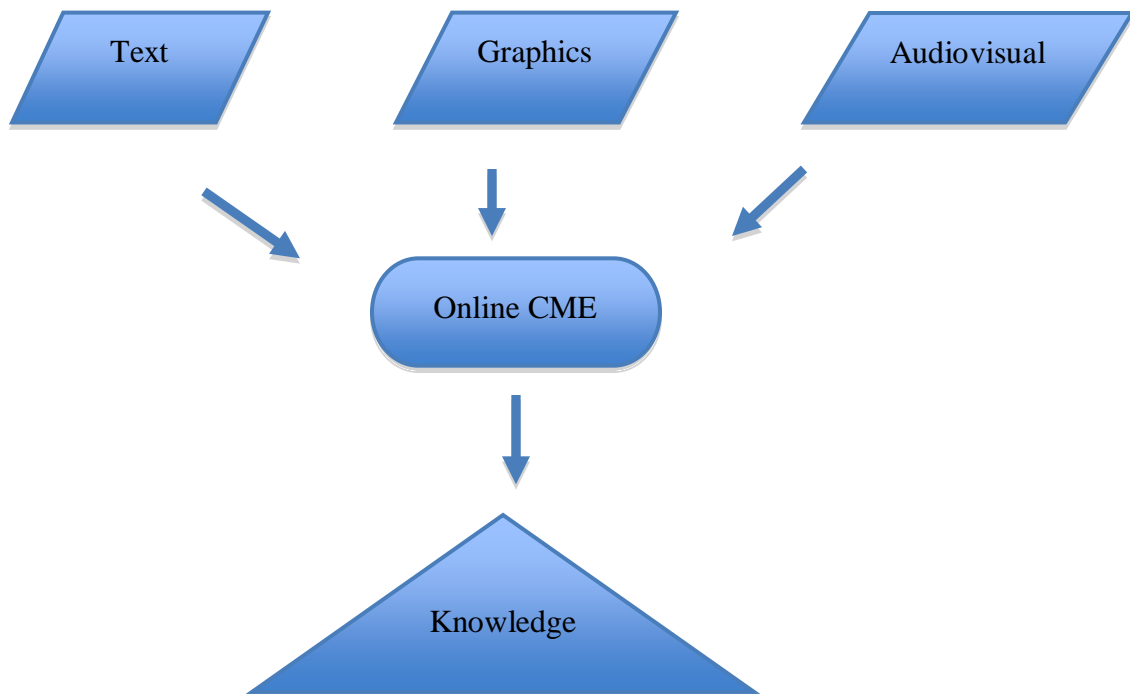
Chapter I provided the reader with an overview of the study and a brief summary of the research literature. Chapter II will continue to delve deeper into the research by including the theoretical and conceptual frameworks. It will also cover and continue to support the research with theory and past studies involving interactivity, knowledge transfer, and CME (online and traditional) effectiveness. Chapter III will discuss the methodology of the study. It will include sampling techniques, the design of the online CME course, and the plans for analyzing the data. Chapter IV will provide the results of the study, and the study will be concluded in Chapter V.

## **Chapter II. Review of Literature**

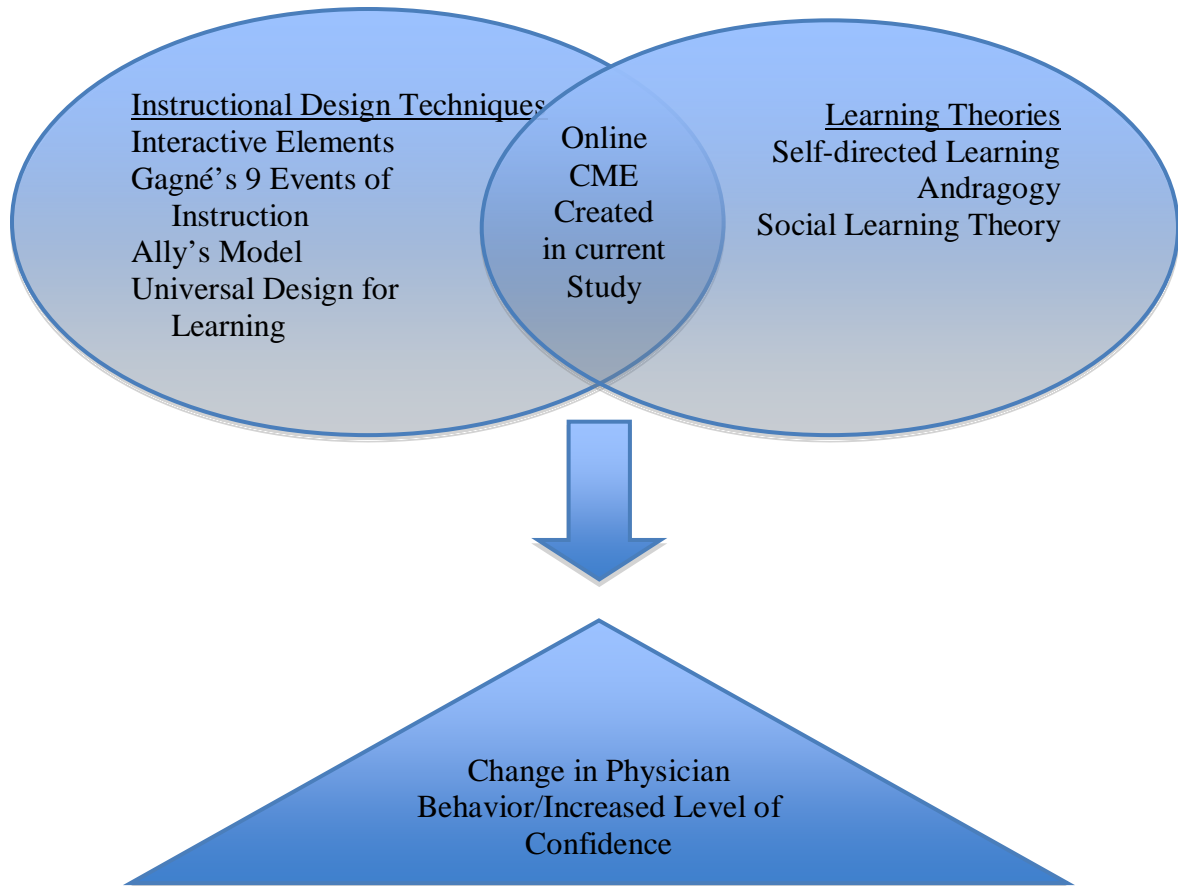
The following literature review will address the effectiveness and instructional design of online Continuing Medical Education (CME) interventions. Conceptual and theoretical frameworks used throughout the study will be introduced. The second part of this review covers the topic of CME in general. It continues by discussing the learning theories and instructional design techniques that will support the decisions made by the researcher in designing the online CME course for the present study. This information is followed by previous studies involving the use and effectiveness of traditional (conferences, workshops, journals, etc) and online forms of CME. The review is concluded with an evaluation by the researcher of three online CME courses currently offered to provide the current view of online CME course offerings.

## Conceptual/Theoretical Frameworks

The conceptual framework found below outlines the present study and will act as an outline for the literature review that follows. Figure 2.1 represents the current state of online CME interventions, and Figure 2.2 represents the online CME intervention created in the current study.



*Figure 2.1.* The current view of online CME. In this view, online CME contains text, graphics, and audiovisual elements. This type of instructional design helps physicians gain the required amount of knowledge, but does not always change a physician's behavior.



*Figure 2.2.* The online CME created in the present study. This online CME utilized instructional design techniques (interactive elements, Gagné's nine events of instruction, Ally's model, and Universal Design for Learning) and learning theories (self-directed learning, Andragogy, and social learning theory) to support the design. By designing the instruction using these supporting elements, the researcher tested the online CME to see if it caused a change in the physicians' behavior and an increased level of confidence with the course content.

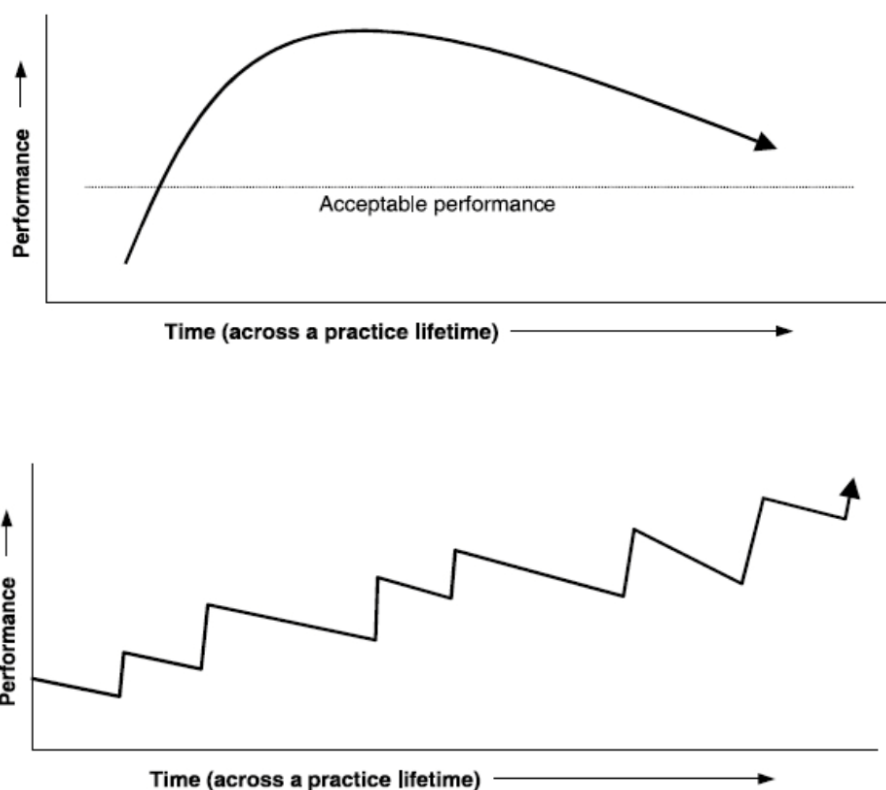
## **Continuing Medical Education**

As previously stated, the American Medical Association defined CME as consisting “of educational activities which serve to maintain, develop, or increase the knowledge, skills, and professional performance and relationships that a physician uses to provide services for patients, the public, or the profession” (Policy H-300.988). CME is the final stage in a physician’s education. This stage continues throughout their career in which they are expected to become lifelong learners.

Handfield-Jones et al. (2002) proposed two different types of competence models for doctors throughout their medical career. The first model parallels the old paradigm, which resembles a rocket launch trajectory (Figure 2.3). In the beginning of his/her career a doctor “rises rapidly above the required level of competence” (p. 950). During the middle of the doctor’s career, he/she will peak in his/her level of competence, and then as time travels on the doctor’s competence will begin to decline and “slip gracefully below a safe level just as retirement age is reached” (p.950).

This type of model is no longer acceptable in today’s society due to the ever-changing medical field. Patients expect doctors to remain at their highest competency level throughout their career. The new paradigm is titled the “on-the-ground voyage” model (Handfield-Jones et al., 2002, p. 951). This model (Figure 2.3, second model) resembles a doctor’s continuous learning path. The change in behavior, due to the new knowledge gained, occurs in steps, and these steps continue to move up along the performance path. Each physician “monitors his or her own learning, managing the design of its continuity and effects” (Mazmanian & Davis, 2002, p. 1059). Even though physicians are expected to “direct his/her own learning,” not all physicians have this

ability (Amin, 2000, p. 499). CME interventions are what physicians can use in order to continuously learn after completing their medical degrees and “to ensure that physicians maintain essential professional vitality throughout their career” (Amin, 2000, p. 499).



*Figure 2.3.* Lifelong competence models for medical doctors. These two models demonstrate the competency models used to describe the variance in competency throughout the career of a medical doctor. The first model is known as the “trajectory model of competence,” and the second model is known as the “on-the-ground voyage model of competence” (Hanfield-Jones et al., 2002, pp. 950-951).

There are a variety of different CME interventions. Traditionally, CME “is a time-based system of credits awarded for attending conferences, workshops, or lectures”



(Mazmanian & Davis, 2002, p. 1059). It can include printed materials, patient educational materials, chart reviews, etc. (Amin, 2000, p. 499). Now with the introduction of computers and the Internet, CME credit can also be acquired through online training, webinars, blogging, and Internet searching and learning (ACCME Annual Report, 2008). Harris, Sklar, Amend, and Novalis-Marine (2010) gathered information about online CME and found that it is becoming increasingly popular with physicians. With their calculations “online CME is likely to comprise 50% of all CME consumed in the United States” within the next 7 years (p. 9).

The goal of CME is to provide further knowledge to update physicians with the most “recent medical advances” (Amin, 2000, p. 499). The implied goals of CME “are as a result of this knowledge, physicians will change their behavior or attitudes” (p. 499). Leberman, McDonald, and Doyle (2006) refer to the change in behavior as a transfer of learning. The authors state that, “transfer of learning occurs when prior-learned knowledge and skills affect the way in which new knowledge and skills are learned and performed” (Leberman et al., 2006, p. 2). The current study addressed whether the instructional design of an online CME course will cause this transfer of learning or change in behavior.

### **Learning Theories and Instructional Design Elements**

CME interventions are presented in a variety of ways. Behind any educational intervention is a learning theory that will support the designer’s ideas. Adult learning theories date back to 1926 “with the founding of the American Association for Adult Education” (Knowles, 1978, p. 28). Since then, adult education and learning theories have become important considerations in instructional design, especially in continuing

education. When designing online learning “materials should be based on proven and sound learning theories” (Ally, 2008, p. 18).

Fortunately, research has been conducted on how to use learning theories to properly design instructional interventions (Ally, 2008). A host of learning theories may be used to design instruction, and it is important to note that designers do not have to use a single theory throughout the design; multiple theories and instructional elements can be utilized when designing instruction. When designing instruction for the online environment, existing learning theories can be adapted and used to design online interventions (Ally, 2008). The researcher adapted multiple learning theories and reviewed past research studies in order to design and develop the online CME course used in the present study. These theories and research studies are discussed in the following section of the literature review.

**Andragogy.** One learning theory used in the current research is the theory of andragogy, first introduced by Malcolm Knowles. His theory (eventually) made six assumptions about adult learning. The first was “the need to know” (Knowles, Holton, & Swanson, 2005, p. 64). This assumption states that adults will invest more energy into learning new content when they have self-evaluated the importance of learning the material. This assumption is made apparent by the burgeoning number of CME courses covering a variety of topics. Clearly, health care practitioners must experience a “need to know” in order to remain competent in their jobs.

The second assumption in andragogy is adults’ “readiness to learn” (Knowles et al., 2005, p. 67). This is a relevant concept in CME; as doctors discover new medical advances, they become motivated to learn and will take the time to complete educational

interventions to ensure they are up-to-date. Doctors are continuously answering questions regarding new information and with this need for more information, they become “ready” to learn. The third assumption is the idea of self-concept. As adults, learners become more independent and self-directed. They decide when learning is necessary and how they will learn the new material. The fourth assumption discusses the level of experience adults bring to a learning environment. With the array of experiences health care professionals bring to each CME intervention, it is important to incorporate these experiences into the design of the curriculum.

For adults, motivation and one’s “orientation to learning” are important. These two factors are the final two assumptions found in Knowles’ concept of andragogy. “Adults are life-centered in their orientation to learning” (Knowles et al., 2005, p. 67). As problems arise, adults become motivated to learn new things in order to solve problems that occur in their lives. Adults “are motivated to learn to the extent that they perceive that learning will help them perform tasks or deal with problems they confront in their life situations” (p. 67). In the present study, the researcher included case studies, which allowed participants to use their experiences in order to answer the case questions. These questions also utilized realistic situations that already, or have the potential to, occur in a health care professionals’ work.

**Self-directed learning.** Along with andragogy, self-directed learning is another adult learning model. Knowles (1975) defines self directed learning as “a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and

evaluating learning outcomes” (p. 18). In self-directed learning there are two main dimensions, self-teaching and autonomy. Both of these dimensions view adult learning as having the student take control of his/her own learning (Knowles et al., 2005). For example, with CME, health care professionals decide which CME course they would like/need to take and it is up to them as individuals to complete the course. Self directed learning makes the assumption that the learner will “become ready to learn what is required to perform their evolving life tasks” (Knowles, 1975, p. 20). This assumption is also supported within the assumptions of Knowles’ (2006) andragogy theory.

The main purpose of self-directed learning is for the learner to take ownership of learning and to remember that each learning situation can be different depending on the learner. The idea of an adult’s building personal autonomy in a variety of learning situations is a key component of self-directed learning (Knowles et al., 2005). The current research utilized a self-directed learning approach in which participants had a variety of experience levels with the content information (Lyme disease). For some participants, the content information could be new and he/she may wish to study further to gain a better understanding. On the contrary, some participants may have previous experience with the content, in which case the information may act as a refresher or review. Regardless of experience level, each participant had the opportunity to move through the course at his/her own pace.

Self-directed learning utilizes different techniques to motivate the learner throughout the learning process. With the more traditional, teacher-directed, learning, a student can become motivated due to the rewards or consequences that are associated with success or failure of learning a new topic or skill. On the contrary, self-directed

learning makes the assumption that students are motivated by their desire to learn, by their “urge to grow”, or by their “need to know something specific” (Knowles, 1975, p. 21). CME is based on the self-directed learning idea of gaining knowledge in order to grow in the medical profession and become a better health care professional due to the efforts put forth in learning new information each year. By having this type of self-motivation, health care professionals often do not need the more traditional, teacher-directed, learning approach.

Jennett, Jones, Mast, Egan, and Hotvedt (1994) also discuss the importance of self-directed learning in CME. The authors explain how each type of instructional intervention has the opportunity for self-directed learning depending on the learner. The most informal type of self-directed learning consists of journal readings and “ad hoc conversations with colleagues” (p. 52). When health care professionals are questioned on a specific topic by a patient, they might have a more semi-structured, self-directed learning strategy. The most formal self-directed learning entails courses, workshops, or printed materials. The important theme around each type of self-directed learning is that within each level, health care professionals (learners) have to take control of their own learning.

Even though self-directed learning has been found to be successful with learners and health care professionals, some are still hesitant about utilizing the self-directed learning modules via the computer and Internet (Mamary & Charles, 2003). Mamary and Charles (2003) conducted a study that addressed and compared the use of instructor-led CME interventions versus self-directed CME interventions. The results of the study provided (2003) the utilization percentages of the types of CME interventions used over a

twelve-month period. In-person conferences were the most preferred type of CME intervention with the self-directed journal review coming in second. Computer CD-ROM instruction was the third choice of preferred method of CME interventions. The use of computers was also included in the data collection of the study. It was found that 80% of health care professionals had a computer at home and 75% of them had Internet access.

With the growth of the Internet and online CME interventions, Mamary and Charles (2003) questioned participants on the reasoning behind not wanting to use self-directed CME interventions. The two barriers that were most commonly reported were the preference for wanting an in-person instruction and lack of computer and Internet knowledge. Participants stated that the lack of interaction between colleagues in an online, self-directed module prevented them from selecting the online module as their intervention choice. The participants also stated that the self-directed interventions required more of a time commitment. The authors suggest that in the future the workplace should offer health care professionals time for “at home” study (Mamary & Charles, 2003). The current study incorporated an online discussion, which could replace the in-person communication with colleagues.

**Social learning theory and self-efficacy.** Bandura’s Social Learning Theory discusses the reciprocal interaction between behaviors, the environment, and the learner. Learning can occur enactively through the learners’ performing an action, or vicariously, through the learners’ viewing of models (live, symbolic, or electronic). In an online class, the learner can interact with the content or with other participants using online discussions, email, etc., which can serve as models to portray the new information or change of behavior. Using the models, learners do not have to perform the new behavior

in order to learn the information; we can learn through observations. The act of performing the learned information or behavior is dependent on additional factors including but limited to: motivation, incentives, perceived need, and self-efficacy (Bandura,1986).

To explain behaviors, Bandura's Social Learning Theory uses the elements of incentives, outcome expectations, and self-efficacy (Strecher, DeVellis, Becker, & Rosenstock, 1986). In this theory, it is thought that people will behave a certain way according to their motivations, incentives, and level of confidence with a particular behavior. An example to illustrate this theory could be related to CME and health care professionals. If a health care professional encounters a patient whom the doctor is unsure how to cure, then the drive to find the cure has become the incentive. The behavior can be identified as "solving the patient's health issue." The health care professional's level of self-efficacy will have an effect on the outcome expectations. If the health care professional has a high level of self-efficacy, he/she could potentially try new methods to solve the patient's illness. However, if the health care professional has a low level of self-efficacy with the new method, he/she may decide to try an "older" route to solve the case. In adult learning, this example demonstrates Knowle's andragogy theory that adults will seek out ways to learn information when they deem it necessary. In this example, the learner's incentive is to solve a problem.

Even though each element used to explain behaviors can be deemed important in the learning process, self-efficacy is the most relevant to Continuing Medical Education and the current research study. Self-efficacy can be defined as "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective

situations” (Bandura, 1995, p. 2). Within Bandura’s theory of social learning, self-efficacy is viewed within a paradigm of how a person engages in a behavior. This paradigm states that a person will engage in a behavior having specific efficacy outcomes in mind. They will also have outcome expectations that are dependent upon their self-efficacy. With an increased or decreased level of self-efficacy, a person’s behavioral change can be affected (Strecher et al., 1986).

A person’s self-efficacy expectations can be influenced by four major sources of information: performance accomplishments, vicarious experiences, verbal persuasion, and one’s psychological state or emotional arousal (Bandura, 1977; Stretcher, et al., 1986). Verbal persuasion was used in the present research study. Verbal persuasion is the act of telling someone what to expect in order to prepare them for specific situations. In a traditional classroom, the instructor often enhances a learner’s self-efficacy by providing feedback. In a self-directed learning intervention, such as an online CME course, it is the learner’s responsibility to take control of his/her learning. For this reason, some learners will do extra research or seek out colleagues to assist them with the learning process. It has been noted that verbal persuasion can cause a weaker level of self-efficacy compared to other information sources. If the learner does not act on the increased self-efficacy, then his/her level will decrease over time (Bandura, 1977a, 1977b).

Vicarious experiences were also used to influence participants’ self-efficacy in the present research study. By using the interactive elements and discussing the content material with other colleagues via the online discussion board, participants could learn from each other’s previous experiences. By observing the suggestions and ideas of



different colleagues, participants had the opportunity to experience and learn the information in various ways (Bandura, 1986).

In order for health care professionals to change their behaviors within their medical practice, they have to first acquire new knowledge, and they must have a high self-efficacy with the new methods for conducting the change (Bandura, 1986). Self-efficacy and outcome expectations are two different concepts both discussed within the Social Learning Theory. Self-efficacy is a learner's "judgment of one's capability to accomplish a certain level of performance" (Bandura, 1986, p. 391). An outcome expectation is the perceived consequence of the behavior. Previous research has shown that studies measuring self-efficacy are concerned with participants' hopes for a favorable outcome. The present research study went beyond this concern to evaluate the participants' "sense of personal mastery" (Bandura, 1977, p. 194). The researcher in the present study evaluated the change in knowledge, self-efficacy, and behavior. If the level of knowledge and confidence in the participants is higher, then when the participant has the opportunity to conduct the new behavior he/she will be more likely to make the change.

**Instructional design frameworks.** Research has also been conducted on how to incorporate learning theories into instruction and the instructional elements to use based on research evidence. In the following section, the researcher will present the literature used to decide how to design the online CME course used in the current research study.

Throughout the design process, the researcher utilized the ADDIE framework. This framework helps designers structure the design and implementation of a training or instructional process. The ADDIE framework uses the acronym ADDIE, which stands for

Analysis, Design, Development, Implementation, and Evaluation. This framework is widely used throughout the instructional design field (Peterson, 2003).

The steps in the ADDIE framework were first used around 1970 by the Air Force. Around the same time period, Hannum (2005) and his colleagues at Florida State were also designing a model to be used for instructional design, the ISD (Instructional Systems Development) model for the U.S. Army. Due to the similar interest of providing “effective and efficient education and training,” the army, as well as larger corporations, adopted the ISD model (Hannum, 2005, p. 7).

With the evolution of computers and the Internet, many designers began to concentrate on how to incorporate technology and not on how to utilize the ISD model, which caused failed attempts to provide high-quality training via the Internet. Designers in this ‘early-computer’ period did not see the advantages of using the same design principles for face-to-face training as online. However, designers continued to suggest the same design principles to be used in online and computer instruction (Hannum, 2005, 2007; Gagné, Wager, and Rojas, 1981; Dempsey & Van Eck, 2007). Sound learning principles and a systematic design should be used when designing any type of instruction whether it is face-to-face or online (Hannum, 2007). Hannum (2005) argues that if implemented correctly, it is still important and should be used when designing training (of any delivery method).

Other theorists have created models and guides to show how to design instruction. Gagné (1985) proposed nine events of instruction that should be used when designing instruction (face-to-face or online). Gagné’s (1985) nine events of instruction include:

1. Gain the attention of the learner

2. Inform the learner of the lesson's objectives
3. Stimulate the recall of the learners' prior knowledge
4. Present the new content
5. Guide learners through the learning process
6. Elicit performance
7. Provide proper feedback
8. Assess performance
9. Assist the learner with retention and learning transfer

Even though all nine events should be considered when designing instruction, it is possible that some situations will not require all nine. This will depend on the learning content and the characteristics of the audience, which should be carefully considered when designing instruction.

More specific to online instruction, Gagné et al. (1981) propose guidelines for a CAI (computer-assisted instruction) author to follow as he/she progresses through the design process. The authors discuss the typical guidelines that are used by online instructional design, which include but are not limited to: "leaving the pace of the lesson under the control of the user," avoiding an abundance of text on one screen, and providing proper instructions for the user (p. 21). Even though some have argued that Gagné's ideas are outdated, Hannum (2005) argues that his principles were based on the cognitive theory and were used as a basis for the ISD model.

Knowles (1975) created a guide for instructors to help them understand how to incorporate self-directed learning throughout a curriculum. One suggestion that is directly related to the present research details how to create an appropriate climate within

instruction. During the introduction or initial class, the instructor needs to create an appropriate climate. This climate needs to be of mutual respect between the instructor and the students. In order to create this type of environment in an online classroom, the instructor should set clear objectives of what the learner should take from the course and to help the students realize each learner enters the course with a variety of experiences and encourage them to utilize those experiences in order to relate and reflect on the new course information. With the present research study, the researcher designed the training so that the participant was clear on the expectations for the course as well as the necessary components he/she had to complete in order to master the course.

Knowles (1975) also describes how he provided feedback to his students throughout the learning process. By providing feedback, the students can evaluate their own learning. With the present research project, the researcher periodically posed questions and provided feedback in order to test the participants' knowledge as they progressed through the course.

Towle and Cottrell (1996) also suggest instructional features that will enhance self-directed learning. They include but are not limited to: "formative assessment and feedback that enables students to monitor and modify their own learning, appropriate summative feedback that tests problem solving rather than rote repetition of facts, and specific performance goals for assignments" (Towle & Cottrell, 1996, p. 358). In the present study, the researcher designed instruction so that learners would be able to build autonomy and complete the training using an independent, self-teaching style of learning. This design used participants' prior experiences, summative and formative assessment

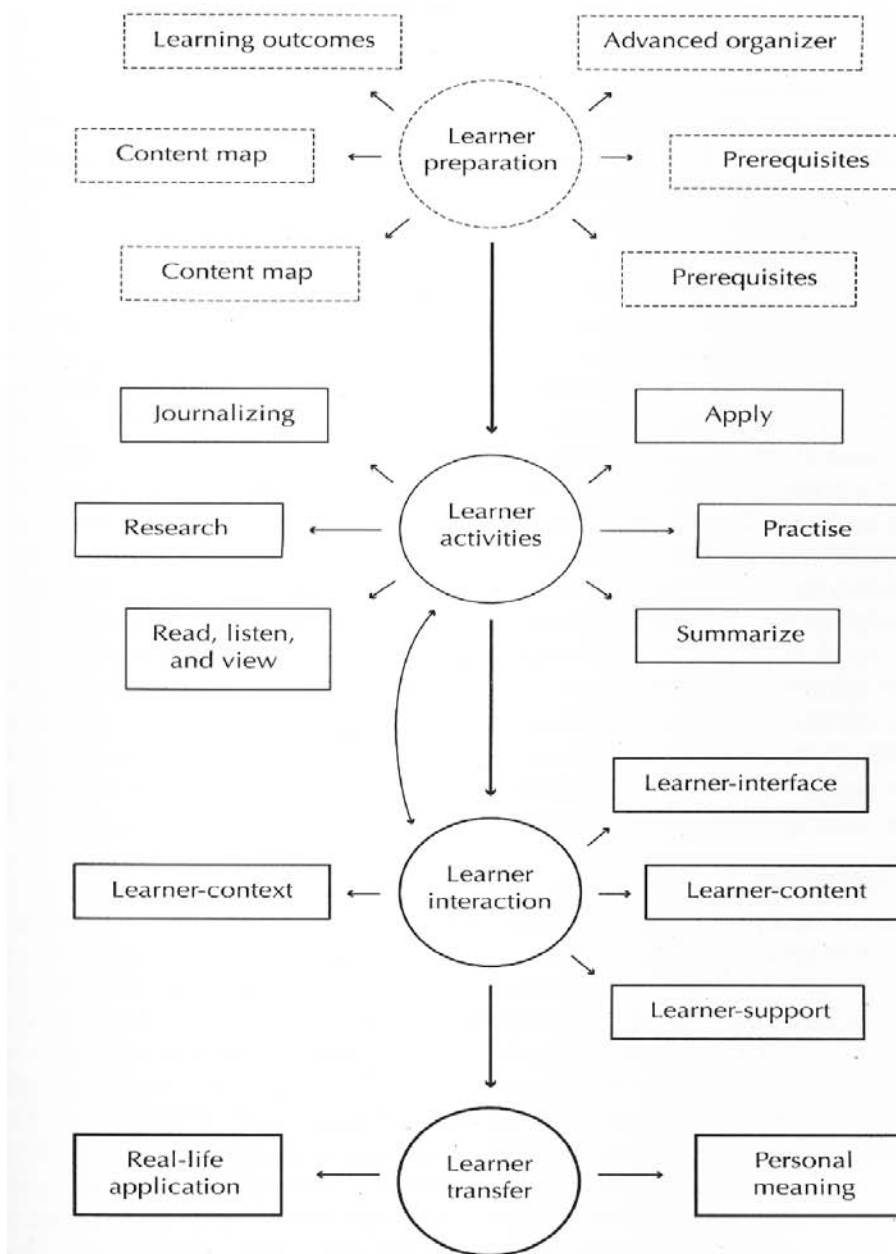
techniques, and interactive, problem-based examples in order for the learner to see how the new information could be used in their everyday practice.

Ally (2008) proposed a model (Figure 2.4) for the various components to include when designing “effective online learning” (p. 37). The model breaks down the learning process into four phases. The first phase covers learner preparation and provides the learner with the overall “big picture” (p. 36). During this phase, the designer ensures that the new information is relevant to the learner and his/her previous experiences. This then serves to motivate the learner to learn the information. This phase also supplies the learner with appropriate objectives and explains the expected learning outcomes of the online training. Ally (2008) also suggests providing the learner with a self-assessment or a pre-test of his/her existing knowledge. The present research incorporated these elements into the designed training, as they are also supported by Knowles’ andragogy and self-directed learning theories and Gagné’s nine events of instruction.

The second and third phases of Ally’s model comprise the online learning activities, while the third phases specifically emphasizes the topic of learner interactions. The types of learning activities offered vary with each type of training. In general, though, the learner should be given the opportunity to apply, practice, and summarize the new content. Throughout the online course, the learner should be provided multiple opportunities for interactions (Ally, 2008). Learners need to successfully interact with the chosen interface without being cognitively overloaded. There should also be an interaction between the content and the learner in order for the learner to “acquire the information needed and to form the knowledge base” (p. 38). In order to help the learner make his/her own connections and relations with the material, there should be

interactions with peers during the learning process. The second and third phases also coincided with Gagne's fourth through sixth events. The present research study utilized practice methods, interaction with content, and interpersonal interaction (Sargaent et al., 2004).

The final phase of Ally's (2008) learning model is the "learner transfer" (p. 37). In this phase, the learner should utilize the new information and be able to apply it to realistic situations. This is the phase that coincides with the third level of Kirkpatrick's model of evaluation, behavior. In the present study, the researcher utilized both Gagné's events of instruction and the components of Ally's model in order to promote "learner transfer" and for the participants to change their behaviors by utilizing the new information.



*Figure 2.4.* Ally's model of the components of effective online training. This model emphasizes the various components Ally (2008) incorporates into online learning in order for it to become the most effective.

The principles of Universal Design for Learning (UDL) were also used in the present study to ensure that all individuals would be able to learn. The concepts behind UDL resulted from the principles of Universal Design (UD), a movement whereby architects began to design buildings that could be utilized by anyone, regardless of physical limitations (Rose & Meyer, 2002; Story, Mueller, & Mace, 1998). The goal of each design was to “accommodate the widest spectrum of users” (Rose & Meyer, 2002, p. 70). Slowly, the UD design concepts used by architects began to spread to other areas, causing designers to realize that “addressing the divergent needs of special populations increases usability for everyone” (Rose & Meyer, 2002, p. 71).

In the 1980s, the Center for Applied Special Technology began investigating how educational opportunities for learners of all abilities could be enhanced using technology. During their research, they found that student failure to master educational objectives most often could be attributed to the instructional design and delivery of the content, and not to the individual student. As a result of these studies, they began reforming curriculum development using the UDL principles (Meyer & Rose, 2006).

When designing curricula for all types of students the principles of Universal Design were applied to education. The adoption of these principles became necessary because of the diverse student population that K-12 educators faced, as well as the inclusion of students with disabilities in the regular classroom. One of the challenges teachers continue to face has been to hold ALL students accountable to the same set of educational learning standards. The Individuals with Disabilities Education Act (IDEA) Amendments of 1997 required teachers to ensure that all students were reaching the standards set within the general education curriculum. The three basic principles used



with UDL help to minimize learning barriers, and provide students with various options for learning (Rose & Meyer, 2002). Along with the basic principles of UDL are guidelines meant to be used in a flexible manner for curriculum development. Even though these principles were originally created for K-12 educators, they can be applied to learners of all ages (Center for Applied Special Technology, 2010).

The first principle covers the aspect of representation. All learners perceive and understand information differently. For this reason, instructional designers must present the material in different ways in order to reach all types of learning styles (Center for Applied Special Technology, 2010; Rose & Meyer, 2002). In order to “reinforce learning and impede decay of knowledge” the designer should utilize various instructional aids, which include but are not limited to graphics, audiovisuals, and videos (Davis et al., 1994, p. 266). Wearne (2008) compares online and face-to-face delivery methods in his article entitled “Trapped in the net? What to look for in a web based CPD program.” The author states, “the key to the effectiveness of education is its design not the medium of its delivery” (p. 847). When discussing online CME, she states that, “merely placing text online for general practitioners to read is unlikely to improve patient outcomes” (p. 847). Online CME interventions should include “active learning” and promote “implementing change in clinical practice” (p. 847). According to the Continuing Medical Education: AMEE Education Guide No 35, web-based CME should be created “appropriately for the medium” (Davis et al., 2008, p.657). The content should “fit easily on a webpage, be in short blocks, allow text to be limited and printed in easy-to-read fonts, allow design to be appealing, and create interactivity with the learner” (p. 657).

The second Universal Design for Learning principle covers how the designer allows learners to express themselves, and the inclusion of interactivity. When designing instruction it is important to provide ways for learners to express what they know. Some students express themselves better verbally and some express themselves better in writing (Center for Applied Special Technology, 2010). Davis et al. (1994) also call for designers to incorporate opportunities for learners to utilize their new skills using role-play, “small-group case discussion,” and other activities that can be reviewed by their peers (p. 266). Designers need to ensure that there is some amount of variety in the ways students express their learning throughout the course. It is also important for students to have some form of interaction with the course itself (Center for Applied Special Technology, 2010).

The third Universal Design for Learning principle involves the motivation and interest of the learner. To support learning, the designer must engage the learner using interactions (Rose & Meyer, 2002). Within CME interventions, it is important to utilize realistic situations and examples in order to help health care professionals see how the new information is relevant to their work (Center for Applied Special Technology, 2010). Davis et al. (1994) also propose to utilize “relevant clinical issues” in the curriculum (p. 266). Knowles’ andragogy theory calls for the use of realistic examples as well. As adults, motivation and one’s “orientation to learning” are important. These two factors are the final two assumptions found in Knowles’ andragogy theory. As problems arise, adults become motivated to learn new things in order to find solutions. Adults “are motivated to learn to the extent that they perceive that learning will help them perform tasks or deal with problems that they confront in their life situations” (Knowles et al.,

2005, p. 67). If the designer incorporates realistic situations that the learner could potentially encounter, then the learner will be more motivated to learn and retain the new information. The third Universal Design for Learning principle also emphasizes the importance of learner choice within the curriculum (Center for Applied Special Technology, 2010). With CME interventions, the health care professional has the ability to choose which CME courses to take in order to remain certified.

Along with learning theories, past research has examined the instructional elements included in CME interventions. A study conducted by Neafsey (1997), examined the effect of a CME course for nurses on their self-efficacy and knowledge. Although the results related to knowledge gain were inconsistent, self-efficacy was largely affected. Based on the results of Neafsey's study, future research should examine the "micro-elements" or instructional design components within the CME intervention in order to determine which elements enhance learning and self-efficacy. Even though Neafsey's study used technology that is now considered outdated, the notion of analyzing instructional components remains important.

In terms of the design of online CME interventions, a plethora of instructional methods are used. Lansing and Zuckerman (2001) discuss the future of CME and how technology will be directly involved with its growth in the coming years. They argue that CME needs to keep up with the technological advances within medicine by upgrading CME interventions. They recommend using more visual effects, interactivity, self-directed learning and even simulations in order for CME interventions to remain on the same technological level as medicine.

Sklar (2009) examines CME websites each year and continues to update his information pertaining to physician CME usage, CME formats, and other general CME facts through his website. In July 2009, he reported out of 300 sites, 89 (31%) of them contained text only and 57 (20%) contained text and graphics. Of the 300 sites available, only 48 (17%) were interactive. Sklar (2009) reports that even though online CME is becoming increasingly popular with physicians, the challenge will be to prove that the online CME courses and training will be effective in changing physician behavior in his/her practice. In 2010, Harris et al. conducted a census of 272 online CME websites. When analyzing the teaching format of each website “106/272 (39%) used a single non-interactive, didactic approach such as text, slides, or repurposed live presentations” (p. 7).

Davis et al. (1994) discuss various studies that have analyzed the instructional design of CME interventions. They conclude that, “little evidence exists for the impact of these measures on either physician performance or health care outcomes” (p. 253). In order to improve CME effectiveness, the authors make three proposals concerning the instructional design of future CME interventions.

The first proposal recommended using “relevant clinical issues” in the curriculum and using various instructional aids which include but are not limited to graphics, audiovisuals, and videos to “reinforce learning and impede decay of knowledge” (Davis et al., 1994, p. 266). Davis et al. (1994) also call for designers to incorporate opportunities for learners to apply their new skills using role-play, “small-group case discussion,” and other activities that can be reviewed by their peers (p. 266). The second proposal by Davis et al. (1994) pertains to the imperativeness of incorporating the “computer and the innovative use of human resources” (p. 266) into the design of CME.

The authors discuss how the computer is an “extraordinarily effective method for the dissemination” of new and ever changing information in the medical field and should be used to design future CME interventions. The utilization of human resources within CME interventions is also encouraged by the authors in order to provide “effective, innovative learning facilitators” within CME interventions (p. 267). The final proposal by Davis et al. (1994) included the use of additional materials in order to reinforce the learning after the initial CME intervention. These include, but are not limited to, patient education materials, audits, and reminders. The present research study took these proposals into account during the design process by including interactivity, case discussions, and instructional aids.

**Interactive Elements.** Interactive elements are also important with online CME curriculum (Casebeer et al., 2003; Casebeer et al., 2004; Cook et al., 2008; Kemper et al., 2002; Wearne, 2008). One way to create an interactive environment in a traditional lecture style intervention is to utilize clicker technology. Eitner, Holst, Wichmann, Karl, Nkenke, and Scholegel (2008) incorporated mobiTED technologies into the classroom as a way for their students to interact during a lecture. “MobiTED is based on an interactive software program that can be used on any standard PC or laptop and with any number of radio transmitters that allow a various number of possible answers per question” (p. 37).

In the study performed by Eitner et al. (2008), the participants were divided into two groups. The control group (Group A) continued with a traditional lecture format in which the teacher stood in front of the students and allowed one student at a time to ask/be asked a question. At the end of the course, the control group completed a written exam to test their knowledge. Group B utilized the new technology and was able to

interact with the teacher during the lecture by having all the students answer questions throughout the lecture. By having the entire class answer questions at the same time, the software was able to analyze the data and report the data in real-time. At the end of the course, Group B completed an examination using the software. The results showed that the students in Group B received a higher score in the knowledge test than Group A. This study shows that even though didactic teaching methods, in general, have been proven to be less effective than other experiential learning methods (Davis 1999; Mansouri & Lockyer, 2007), when including interactive elements, such as clicker technology, the intervention is more effective (Eitner et al., 2008). The present study applied a similar concept to online interventions by including interactive components to what previously had been a didactic method – onscreen text.

Evans and Gibbons (2007) conducted a study using undergraduates working towards a business and management degree. In the study, they used an interactive computer environment in order to teach the process of a bicycle pump. In the non-interactive group, the participants were given a computer program that contained solely text and graphics explaining the process. The interactive group was given the ability to click a button on the screen in order to move on to the next process. This allowed the learner to move through the material at his/her own pace. The interactive group was also provided “self-assessment questions” (p. 1151). “These required the learner to choose an answer from five options by dragging the chosen segment of text to the answer box” (p. 1151). The last element for the interactive group “consisted of an interactive simulation” (p. 1152). The simulation allowed the participants to actually see the bicycle pump in action.

Each group was required to participate in a pre-test, which consisted of a single open-ended question having students describe how a bicycle pump operates. Both groups completed the required post-test at the end of the intervention. The post-test contained “two retention questions and three transfer questions” (Evans & Gibbons, 2007, p. 1152). The transfer questions asked learners to apply their new knowledge to realistic situations that could arise when using a bicycle pump. The results concluded that the two groups did not have a significant difference in scores on the retention questions. However, the interactive group did perform “significantly better in the transfer test than those using the non-interactive lesson” (Evans & Gibbons, 2007, p. 1156). This type of knowledge transfer test shows that the participants can utilize the information after the training. However, the study does not show if the participants will use the information in the future. Being able to use the information initially may indicate that learners have a higher self-efficacy with the material, which is one variable in the present study. Unfortunately, the study conducted by Evans and Gibbons (2007) lacked an evaluation of the learners’ actions after completing the course, which would have more clearly demonstrated the learners’ ability to retain and transfer knowledge.

**Collaboration.** Collaboration in an online environment is an instructional element that is beginning to arise in CME interventions (Khan, 2001). Even though the majority of online CME instruction is “self-paced e-learning,” at least “10-12 percent is in real-time collaboration-based learning” (Adkins, 2007, Healthcare section para. 1). Wikis, blogs, podcasts, and online discussion forums are all web-based tools that have the potential of “improving and adding new collaborative dimensions” to web-based CME interventions (Boulos, Maramba, & Wheeler, 2006, para. 2). Sitzmann, Wisher, Stewart,

and Kraiger (2005) conducted a meta-analysis on over 100 studies comparing web-based and classroom instruction when teaching declarative knowledge. Their findings supported the use of learner interaction throughout a web-based course.

Sargeant, Purdy, Allen, Nadkarni, Watton and O'Brien (2000) conducted a study utilizing interactive modules and online discussion board forums. This study is related to the present research study as it also contained interactive modules, assessments, and case-based discussion forums. The researchers reported that 19 out of the 31 participants assessed the course content. Of those nineteen, 14 responded to the online case discussion. Within the discussion boards, participants interacted with the instructor and the case studies. However, they interacted with each other more sporadically. On average, participants rated the components of the discussion board (level of comfort, value of discussions, level of understanding) between 3.5 and 4.4 of 5 possible points.

Wiecha and Barrie (2002) also conducted a similar study to the present research study. The authors created an online CME course on type 2 Diabetes. The online course consisted of seven interactive modules and two online discussion boards. Participants were given seven weeks to complete the training and at the time of publication, the authors reported feedback that was "overwhelmingly positive" (p. 929). Within the discussion board postings, it was evident that participants were applying the new information in their medical practice. This study reiterates the positive aspects of online collaboration via online discussion boards and how participants transfer the new knowledge to their practice. Within both studies, the authors did not report on a formative assessment of knowledge gain for the participants after the training implementation.



Even though Wiecha and Barrie's (2002) study showed increased knowledge application and transfer, there are barriers to overcome when using online discussion boards. These barriers can include the level of comfort participants have with online tools such as discussion boards, computer knowledge, technical difficulties, and lack of motivation (Gagnon, Legare, Labrecque, Fremont, Cauchon, & Desmartis, 2007; Guan, Tregonning, & Keenan, 2008; Sargeant et al., 2000). Designers will need to continue to improve upon the utilization of collaborative web-based tools to find ways to overcome these barriers. The present research study provided detailed instruction on how to use the Wikispaces<sup>®</sup> platform in an attempt to reduce technical difficulties and address lack of computer knowledge.

### **Evaluation of CME**

Evaluation is an important part of any type of training. In the business world, the Human Resource department evaluates training in order to justify the budget and to analyze how to continually improve training in order to improve other aspects of the business (Kirkpatrick & Kirkpatrick, 2006). With CME, it is important to evaluate courses to ensure that doctors are staying current on new medical advances and changing their behaviors as new information is presented. The effectiveness of CME is also discussed in the continuous education of nurses. Sadera and Fisher (2009) discuss current issues with distance CME in nursing education. One looming question is CME course quality, mainly due to the quantity of courses in development and rate at which they are being developed.

Davis, Lindsay and Mazmanian (1994) stress the importance of CME providers selecting the appropriate tools that will match "the importance of their questions and the

desired or appropriate level of outcome” (p. 267). If CME providers take the time to evaluate the intervention, the gap between the research and practice will be smaller and hopefully will show that physicians do change their behavior as new information is presented. Instructional designers working with CME need to “implement strategies to effectively integrate pedagogical principles in order to return quality to CE learning opportunities” (Sadrea & Fisher, 2009, p. 153). The current research study evaluated the designed online CME course based on knowledge gain, self-efficacy levels, and a change in behavior after completing the online CME course.

Kirkpatrick created an evaluation framework to help organizations and instructional designers evaluate all forms of training programs. His framework utilizes four different levels: “Reaction, Learning, Behavior, and Results” (Kirkpatrick, 1959a; Kirkpatrick & Kirkpatrick, 2006, p. 21). The first level “measures how those who participate in the program react to it” (Kirkpatrick & Kirkpatrick, 2006, p. 21) and how they feel after completing the training session (Kirkpatrick, 1959a). The second level, involving learning, measures whether participants have changed their attitudes or increased their knowledge or skill level. It is important to note that a good reaction from the participants does not always equal successful learning results (Kirkpatrick, 1959b). These two levels are often evaluated with CME instructional interventions or training (Curran & Fleet, 2005; Curran et al., 2010; Evans & Gibbons, 2007; Kemper et al., 2002; Lipman et al., 2001; Mazzoleni et al., 2009). Level three, behavior, evaluates whether learners change their behavior after participating in the training program. The results level (fourth level) analyzes the results obtained by having learners participate in the training program. Results can be defined in multiple ways, including but not limited to:

production, sales, number of accidents, or profit margins. It is suggested that evaluators conduct evaluations from all four levels. However, this is not always the case in many training programs (Kirkpatrick, 1960a, 1960b; Kirkpatrick & Kirkpatrick, 2006).

Even though Kirkpatrick's framework is well known, some studies have evaluated CME interventions using a modified version of Kirkpatrick's framework. Curran and Fleet (2005) used "a modified version of Kirkpatrick's framework for summative evaluation" (p. 563) in their meta-analysis on Internet delivered CME interventions. Out of the 31 studies that incorporated an evaluation, "25 (80.6%) included evaluations of learner satisfaction, 16 (51.6%) studies encompassed an evaluation of learning outcomes, and 2 (6.5%) studies evaluated performance change in clinical practice" (p. 563). When analyzing the change in physician behavior, both studies included in the analysis, used self-reporting methods, in much the same manner as the present study.

Tian, Atkinson, Portnoy and Gold (2007) also conducted a systematic review of the evaluation levels in formal CME using a modified version of Kirkpatrick's model. Sixty-six percent of the chosen studies evaluated one level, and 28% evaluated two levels. Surprisingly, only 6% of the chosen studies evaluated all three levels. These two reviews show that some studies do analyze a change in physician behavior, which will be the focus of the present study. In order to evaluate the physicians' change in behavior, self-reporting was used by 24% of the studies in Tian et al.'s (2007) review of evaluation, and 100% of the studies in Curran and Fleet's (2005) study. The present research study also used self-reporting measures to analyze change in behavior and self-efficacy. The Curran and Fleet (2005) and Tian et al. (2007) studies also confirm evaluation beyond

participant satisfaction continues to be an uncommon occurrence (Tian et al., 2007, p. 31).

As with Tian et al.'s (2007) and Curran and Fleet's (2005) studies self-reporting on behavior, Umble, Cervero, Yang, and Atkinson (2000) also used self-reporting to evaluate Continuing Education on the levels of knowledge, self-efficacy, agreement, and adherence. Their study compared a traditional, classroom-based class and a class given through the use of telecasts. To evaluate and compare the two courses, the authors distributed self-reporting surveys before the course, immediately after the course, and three months after the course (Umble et al., 2000). The present study utilized a similar method by providing surveys to participants before, directly after, and three weeks after the training.

In 1995, Davis, Thomson, Oxman, and Haynes conducted a review of a variety of CME methods to determine if the methods were effective in changing physician behavior after implementation of the educational interventions. The authors included the following interventions in their review: "educational materials (including non-interactive printed, audiovisual, and computer-produced information), formal CME programs such as conferences, seminars, and workshops, ... outreach visits, local opinion leaders, patient education materials, audits, and reminders" (p. 701). Davis et al. (1995) found the more formal CME methods, such as conferences, were among the interventions that did not cause a change in physician behavior. However, educational materials did show a positive effect on change in four of the seven reviewed trials. This type of evidence shows how early educational materials such as printed text and articles reviewed by physicians has the potential of showing a positive change in his/her behavior within their

practice. In 1998, Davis did another review of educational activities. In this review, he confirmed that educational materials were effective but did not “demonstrate an effect” to change physician behavior (Davis, 1998a, p. 31).

Davis et al. (1999) conducted a meta-analysis on the effectiveness of formal CME on the change in physician behavior. In their analysis, they confirmed previous reviews that didactic interventions were not successful in changing physician behavior. Even though they did not change physician behavior, the researchers did make note of the change in knowledge of the participating physicians. In 2007, Mansouri and Lockyer also confirmed previous results that, overall, traditional (non web-based) CME is effective. However, the effect size between physician participation and knowledge was larger than participation and physician change in behavior. The review conducted in 1999 by Davis et al., found that interactive interventions such as case studies, role-play, and hands-on activities did play a part in changing physicians’ behavior, but that didactic interventions were not successful in changing physician behavior.

With the above reviews (Davis et al., 1995; Davis 1998a; Davis et al., 1999; Mansouri & Lockyer, 2007), suggestions were made on how to improve future CME interventions. Davis et al. (1995) stated that physicians need more than text on a page in order to affect their behaviors. In 1999, it was also noted that providing additional educational materials for patients created a difference in physician behavior (Davis et al., 1999). Davis and Galbraith (2009) recommended that CME “include multiple exposures” of the educational material, utilize multiple instructional methods, and provide more than printed media alone during CME interventions (p. 45S) in order to improve physician performance. The current research study applied these ideas to an

online course environment to test for the effectiveness of knowledge gain, self-efficacy, and behavioral change.

Thus far, the reviews and studies discussed predominately have covered interventions that do not include the Internet. When evaluating online CME, there is little consistency in the level of evaluation included in each study. It is popular to test for the effectiveness of online CME by studying user satisfaction and the immediate knowledge gains once participants have completed the training.

Mazzoleni et al. (2009) conducted an evaluation of ten online courses offered through a Moodle (an online open-source web application) platform involving a variety of medical topics. Each course contained self-directed learning, case studies, and a pre-post test. The authors tested each course for knowledge gain, user satisfaction, and the number of interactions with the online tutor provided through the Moodle platform. Their results were positive with over 70% for knowledge gain, and user satisfaction was in the upper two points of the scale.

Cassebeer et al. (2003) created similar web-based instruction (compared to Mazzoleni et al.) on the topic of “improving chlamydial-screening rates among primary care physicians” (p. 2). The authors included three modules in order to expose the participants to the content material more than once. Their course also included case studies as well as interactivity, audit-feedback, and patient-education materials. Instead of using a pre- and post- test method, the authors utilized a control group and compared the post-test results to the group who did not participate in the intervention. There was a significant difference in the scores between the control group and the intervention

physicians. This proves that the knowledge, skills, and attitudes of the physicians did improve by completing the intervention.

Kepmer et al. (2002) conducted a randomized trial of an Internet curriculum. Their subject matter included information on herbs and other dietary supplements. A variety of health care professionals, including physicians, dietitians, pharmacists, and nurses participated in the trial. The trial contained three questionnaires that tested for knowledge, confidence levels, and their amount of communication between patients and other colleagues regarding the content. The first questionnaire was completed before the intervention, the second directly after the intervention, and the third anywhere from 10-15 weeks after the intervention. The Internet curriculum under review contained three different elements. The first utilized case studies and could be completed “interactively on the project’s Internet site” (p. 864). The second element included “evidence-based Internet resources” (p. 864), and the third element contained a listserv in which “participants were encouraged [but not required] to post clinical questions to the list and answer other participants’ questions” (p. 864). The results of the trial show there was a significant increase in the knowledge, confidence, and communication of the content material. Even though this study evaluated communication in addition to satisfaction and knowledge, it did not evaluate whether the participants changed their behavior after completing the intervention.

Wutoh et al. (2004) conducted a review of CME interventions that were Internet-based. In their review they included interventions that utilized email listservs, trials that studied printed materials versus web interventions, trials that studied didactic interventions versus web based interventions, and trials that converted the original

content and into a CME course delivered over the World Wide Web. Of the reviewed trials, the authors concluded that Internet based interventions are just as effective in imparting knowledge as other CME interventions. However, they found that at this time, little is known about whether the knowledge gained is being used to change physicians' behavior. One of the authors' concerns is that designers will simply "apply the same curricula as traditional formats of CME" to the web-based format (p. 28). This could transfer the "same deficiencies" of the original course to the web-based course (p. 28). To solve this problem, "new, innovative, interactive programs need to be created and tested to see if they are effective" (p. 28). Even with the sixteen trials that were evaluated by Wutoh et al. (2004), the change in physician behavior as a result of online CME was not examined. The next studies reviewed have attempted to demonstrate that online CME interventions can bring about behavioral change.

Hansen (2008) conducted a study on the transfer of knowledge in online learning environments versus the traditional classroom environment. This study is tangentially related to the present research study as it was conducted throughout a semester in a midsized university. The online class conducted weekly online chats using a software system, "Blackboard," while the traditional course met twice a week in a classroom environment. The study tested the participants' knowledge using online tests given throughout the course. The knowledge gain between the two courses was essentially the same. For this reason, testing for knowledge transfer would be essential.

Knowledge transfer was tested by having students complete a group project that required the students to apply their new knowledge in a realistic situation (Hansen, 2008). The results showed that the online class did produce better results involving knowledge



transfer. Even though the online group had better results, the test of knowledge transfer was conducted immediately following the course. The study did not test whether the students used the information in the future.

Hansen (2008) provided reasons he believed knowledge transfer was greater in an online environment. First, he suggested that, “online courses tend to foster greater ownership of the course material by virtue of a more independent learning process” (p. 96). By having to comprehend the material independently, participants are more likely to create their own way of understanding. Second, Hansen (2008) suggested, “online students will have more communication and a greater sense of community” (p. 96). By not seeing the instructor each week, it is more important for the student to seek out the teacher if they do not understand the material. In CME courses, this could also be the case. Physicians who are completing the course will be forced to research or ask fellow physicians questions if they do not understand the material. By forcing this communication, participants will take ownership of their learning. Even though Hansen’s (2008) study took place within a university, his study is a good example for the present study. The present study provided participants the opportunity to communicate with their colleagues during the course. The course content of the present study was similar to Hansen’s study in that a lecture was delivered using a slide set, as well as case studies with an online discussion. However, the course in the present study tested the interactive elements provided during the course content instead of comparing online and face-to-face.

Fordis et al. (2005) also conducted a trial involving the comparison of a live, interactive workshop to an Internet-based CME course. In the trial, there were two

randomized groups of physicians. One group participated in a live, interactive workshop and the other randomized group participated in an online workshop both covering the same content material. The course material was somewhat similar to the present study as it utilized case studies. Once the training was complete, both groups participated in a knowledge-based test. With each type of CME, the knowledge test scores improved.

The behavioral change in Fordis et al.'s (2005) study was tested using patient chart reviews. When analyzing behavioral change, "only the online CME participants demonstrated behavioral change" (Fordis et al., 2005, p. 1049). By conducting chart reviews, the authors were able to analyze the participants' behaviors more so than with self-reported data. However, this is a time consuming activity and was beyond the scope of the present research study.

In 2004, "a feasibility study was conducted, followed by a time series trial and ancillary analyses of data to evaluate the effectiveness of on-line CME courses" (Casebeer et al., p. 69). In this study, the authors used seventeen text-based courses (including "flat text, images, slides, streaming audiotape, and archived webcasts" (p.70)) and thirteen case-based courses. Case-based courses also had the potential of including video and audio elements. This study evaluated thirty different courses, whereas the present study created two variations of a single course to evaluate. With the present study and the study by Casebeer et al. (2004), each participant was asked to participate in a pre-test, post-test, and a follow-up test.

Another aspect that separates the present study from the study conducted by Casebeer et al. (2004), was the question formats used in the three tests. In Casebeer et al.'s (2004) study, all three tests contained six knowledge questions, one question

involving change in physician behavior, and one question involving the course content. On the pre-test, the change question asked the physician to identify a “change that may need to be made regarding target behavior” (p. 71). The post-test had the physician identify a “change area that is intended to be made” (p. 71). The follow-up test asked the physician what changes had been made to his practice.

With regard to knowledge, the average test scores showed an increase in physicians’ knowledge after completing the CME courses (Casebeer et al., 2004). Although there were differences in how the behaviors of the physicians changed between what they intended to change and what they actually changed, there were reported differences in the physicians’ behavior after completing the intervention. The change in behavior was evaluated using a self-reporting method. This method has its advantages and disadvantages which will also be seen in the present study.

Casebeer et al.’s (2004) study showed an increase in knowledge and a change in physician behavior. When looking at the physicians’ “ranking of characteristics influencing course selection...interactivity was considered important to physician participation” (pp. 72-73). The exact content of the courses chosen and the inconsistency of the number of doctors that completed each of the phases in the study can be considered limitations. However, the idea of evaluating more than one online CME course could be beneficial in future research.

Casebeer et al. (2008) conducted a trial in which physicians participated in 48 different Internet-based CME activities. Half of the activities were text-based with the other half were case-based. This trial used a uniform evaluation for a variety of online CME interventions, which included case vignettes accompanied by multiple-choice

questions. The case vignettes were delivered to participants directly following the CME activity. The results concluded that physicians who participated in the selected activities were more likely to apply the new knowledge and make more clinical decisions that are based on knowledgeable evidence.

The present study was tangentially related to the study conducted by Casebeer et al. (2008) by using case studies to see if participants would follow the correct action when presented with the case. However, the study by Casebeer et al. (2008) did not provide clear evidence that the participants did change their behavior over time. The present study improved upon Casebeer et al.'s (2008) study by questioning participants' behavior change three weeks after the intervention along with testing for a change in their self-efficacy.

In 2008, Cook et al. conducted a meta-analysis involving Internet-based learning in CME. When comparing no intervention with Internet-based learning, there was a knowledge increase. However, the results for skills and behavioral change were inconsistent. Cook et al. (2008) also analyzed Internet and non-Internet interventions for satisfaction, knowledge, skills, and behavioral change. Even though the results were also inconsistent, the authors did find statistical differences after breaking down the results into smaller subgroups.

When studying user satisfaction, Cook et al. (2008) "found statistically significant treatment subgroup interactions favoring short courses, high-quality studies, and single-instance rather than ongoing-access Internet based interventions" (p.1188). With regard to knowledge, the "effect sizes were significantly higher for Internet-based course using discussion versus no discussion" (p. 1188). In the skills category, there were

“statistically significant treatment-subgroup interactions favoring higher levels of interactivity, practice exercises, and peer discussion” (p. 1189). “Single-instance interventions” also had a higher effect size (in the skills category) than the interventions with unlimited access. (p. 1189). The category of behavioral change also found that “single-instance interventions” were more favorable. These results support the instructional design decisions of the current research study in that peer discussion, interactivity, and practice exercises are helpful in online courses. One limitation of this particular study was the extremely small sample size for the skills and behavioral subgroup results.

Dunet, Reyes, Grossniklaus, Volansky, and Blanck (2008) conducted a thorough evaluation of an online training course for physicians on Hemochromatosis. The training included self-guided modules, which contained links to “related sites and research articles” (p. 87). The training also incorporated educational material for patient distribution. Once the participants completed the training they completed three types of evaluations. The first was a “formative evaluation” which covered the design and content of the training. The second evaluation was the “process evaluation,” which covered “knowledge gains and increases in confidence and motivation” (p. 67). The first two levels were completed immediately following the training. The third level of evaluation was the “outcome evaluation” which evaluated “changes in clinical practice attributed to training participation” (p. 67). The third level of evaluation was conducted six months after the training was completed.

The methods of evaluation used by Dunet et al. (2008) were similar to those used in the present research study, but differences occurred in the amount of time between the

training and the third level of evaluations [3 weeks (present) and 6 months (Dunet et al., 2008)]. After reviewing the evaluations, the researchers concluded that the CME course was successful in improving physician knowledge and causing a change in their behavior (Dunet et al., 2008). As in the present study, the method of evaluation was a self-reported questionnaire assessing behavioral change. Dunet et al. (2008) recommended that further research would need to be conducted to compare actual patient chart audits with the physicians' self-reported results.

Another difference between the study performed by Dunet et al. (2008) and the present study was the course content. The article did not reveal any information pertaining to the exact course components. However, the study's course did include case studies, which are similar to the present study, but it also stated the course contained a variety of patient education materials, which the present study did not provide.

In general, research indicates that online courses are just as effective as face-to-face courses with regard to knowledge gains (Casebeer et al., 2003; Casebeer et al., 2004; Casebeer et al., 2008; Dunet et al., 2008; Fordis et al., 2005; Hansen, 2008; Kemper et al., 2002; Mazzoleni et al., 2009; Wutoh et al., 2004). However, testing for actual change in behavior by the participants can be challenging. Many studies also compare multiple online interventions or courses instead of individual instructional components within one curriculum. The present study utilized variations of the studies discussed in this section to evaluate how interactive and collaboration elements can affect physicians' behavior and self-efficacy.

### **Evaluation of 3 Current CME Courses**

In order to gain a deeper understanding of the current state of online CME courses, the researcher participated in different online courses looking for some of the instructional design elements utilized in the present research study. Due to the accessibility and time constraints, the researcher participated in three courses that had similar content to the present research study. Specifically, the researcher evaluated each course based on the following questions:

1. What evidence was provided that participants learned from the CME course? Did the course provider utilize Kirkpatrick's Level 2 evaluation?
2. Did the course follow Gagné's nine events of instruction?
3. What elements of the Universal Design for Learning did the course designer use? Did the designer take into account the various learning styles?

The present research study evaluated learners' knowledge gain, incorporated Gagné's nine events of instruction, and applied principles of Universal Design for Learning. Even though the evaluation did not include all of the elements used in the design of the online CME course within the current study, it provided the researcher with an idea of how current online courses are designed.

Each evaluation question was represented using a matrix, which contained specific questions to be evaluated across the three online CME courses (Appendix B). To validate the three matrices the researcher conferred with a Subject Matter Expert in the field of Instructional Design to provide feedback on the validity of the questions being asked. In addition, the researcher participated in each online course as a learner. While

participating in each course, she completed each matrix according to the questions presented.

After completing all three courses, the researcher used the information within the matrices to provide recommendations for future designs of online CME interventions. The researcher also incorporated the recommendations into the design of the online CME course within the present research study. The researcher chose the three CME courses due to the similarities the content had with the content in the current study. All three courses were based on the topic of infectious diseases which is how Lyme disease can be categorized, and as it was the topic of the designed course within the present study.

The first course evaluated, “Lyme Disease Case Study Course” was offered by the Infectious Diseases Society of America (IDSA). It was a free, online course for physicians, nurses, and other clinicians. It covered how to recognize, diagnose, and treat Lyme disease. The course was an “interactive course [that] consists of a series of case studies and is based on the IDSA guideline *The Clinical Assessment, Treatment, and Prevention of Lyme Disease, Human Granulocytic Anaplasmosis and Babesiosis*” (Infectious Disease Society of America, 2009). Within each matrix this course is labeled as “IDSA Course – Lyme Disease.”

There were six total case studies within the IDSA course and each case study was worth 0.25 CME credits for a possible total of 1.5 CME credits. To receive CME credit, “the learner must complete at least four of the six cases, score 70% correct or higher on the post-test, and complete the evaluation” (Infectious Disease Society of America, 2009). By the end of the course the learner should be “better able” to evaluate, diagnose,



and use effective therapy to treat Lyme disease as well as understand the IDSA's Lyme disease treatment guidelines.

The second course, "Shingles: Diagnosis and Management of Herpes Zoster and Postherpetic Neuralgia," could be taken through the BMJ (British Medical Journal) Learning website. This online course was considered a "just in time" type module offered to all health care professionals (medical students, general practitioners, hospital doctors, nurses, etc.). It covered the "essential facts on diagnosing and treating herpes zoster and the treatment of postherpetic neuralgia," an infectious disease (Johnson, 2010). Due to the fact that the BMJ Learning is primarily for British medical practitioners, it was unclear how practitioners within the United States could receive CME credit. However, British health care professionals could receive credit if they completed all sections and passed the post-test with a score of at least seventy percent. The website did not explain how many "hours of credit" the health care professional would receive after completing the course (Johnson, 2010). Within each matrix this course is labeled as "BMJ Learning Course-Shingles."

The third course was offered through the Medscape CME website. It was entitled "Improving Clinical Outcomes: New opportunities for the Prevention and Management of HPV-Related Diseases." This online course was designed for gynecologic oncologists and other health care professionals. It covered information regarding the management and prevention of HPV-related diseases (which are also considered an infectious disease). CME credit of 1.50 hours was awarded once the health care professional participated in all four sections. Each section contained a video presentation with slides, audio, and a video of the speaker explaining the slides. The learner also needed to read the author

disclosures, objectives, and other introductory information. To receive proper credit, the learner had to complete a post-test and activity evaluation (Hatch, Cox, & Huh, 2010).

Within each matrix this course is labeled as “Medscape Course - HPV.”

The first matrix (Appendix B) was used to analyze whether the CME courses involved a method for evaluating learning within the participants. The matrix included the following questions:

1. Did the course provide a way to assess the learner’s current knowledge (prior to course participation) of the presented content?
2. Did the course provide a way to assess the amount of knowledge gained by the learner after participating in the course?
3. Did the course provide feedback for the learner on his/her learning?
4. Were the assessments related to the learner’s work environment?

The first two questions addressed whether the course evaluated at the second level of Kirkpatrick’s framework. The final question was grounded in Knowles’ theory of adult learning, andragogy. Adults “are motivated to learn to the extent that they perceive that learning will help them perform tasks or deal with problems that they confront in their life situations” (Knowles et al. 2005, p. 67). If learners are assessed using realistic examples it will not only prove to the course designer/evaluator that the learner can apply the new information, but it will also help learners become motivated to utilize the new information in their current work environment.

As noted in the matrix, the use of a post-test was more common than the use of a pre-test. Utilizing only a post-test was helpful to gauge how the learner responded to content questions. However, it did not show that the course helped in providing those

answers. Without a pre-test, the course designer/evaluator would not know whether the course was helping learners understand the information or if the participants' knowledge was all prior knowledge and the course needed to cover the content in greater depth.

The first course was the only course that utilized the pre-test versus post-test technique. By comparing the two scores the course evaluator/designer had the opportunity to see if the learners' experiences within the course caused a knowledge gain. The second and third courses utilized the post-test to evaluate participant learning at the conclusion of the course. However, the two courses differed in the use of a cut score to determine mastery. On both the first and second courses, participants needed to score at least a seventy percent in order to receive CME credit. In the third course, only two post-test questions were given. A participant could miss one question and still be able to obtain CME credit. In other words, learners in the third course could earn a 50% and still obtain credit.

Assessment item types used in all three courses were very limited. In fact, all three courses used solely multiple-choice questions. This resulted in test questions that were limited on the amount of knowledge that could be tested. The learner could potentially learn much more or much less, but the course evaluator/designer would not know unless there were more questions presented or a different format used.

Overall, feedback was provided to learners in each course. However, it was only provided at the end for the majority of the courses. This feedback was helpful to learners to see what they still did not understand. On the other hand, the feedback was often scripted. This could have caused the learner to exit the course still not understanding various concepts.

The second matrix evaluated (Appendix B) whether each CME course incorporated Gagné's nine events of instruction within the course design. Each question was parallel to Gagné's nine events (gain attention, provide objectives, stimulate prior knowledge, present content, provide guidance, elicit performance, provide feedback, assess performance, and assist with retention). Even though all nine events should be considered when designing instruction, it is possible that some situations will not require all nine. This will depend on the learning content and the characteristics of the audience, which should be carefully considered when designing instruction (Gagné, 1985). The researcher took these characteristics into consideration when answering each question within the matrix.

The first event called for the designer to gain the attention of the learner. All three courses lacked this element. If health care professionals understood the importance or in some cases, urgency, of the subject, he/she would be more likely to study the content and apply the information to their daily work. According to Knowles' andragogy theory, adults need to understand why they are learning the material and how it applies to their current life (Knowles et al., 2005).

The second event involved learning objectives. Two out of three of the courses provided objectives at the beginning of the course. The IDSA course provided overall objectives at the beginning as well as individual case objectives before each case study. Even though the Medscape course provided overall objectives, one of the video presentations presented objectives but only for that particular slide set. The BMJ Learning course however, did not provide objectives. The third event involved

stimulating prior knowledge. This concept was addressed in the first matrix. Only the IDSA course provided this stimulation using a pre-test before each case study.

Each of the three courses utilized the fourth and fifth events of instruction. All of the courses presented the new information in a plethora of ways. The IDSA course presented the information on multiple pages in order to prevent cognitive overload by having a large amount of text on one page. The disadvantage of the presentation of the material within the IDSA course was how each page began to look identical to the learner after the first few case studies. The BMJ Learning course presented the new information in a repetitive manner. Each page contained vast amounts of text that eventually began to blend together page after page. This method of presentation can cause a learner to become unmotivated to read the information. The Medscape course had a different presentation utilizing videos as well as chunking the information into smaller segments of twenty minutes or less. The methods of representation will be discussed further in the 3<sup>rd</sup> Matrix discussion. The fifth element assessed whether the course provided any guidance throughout the course regarding the learning process. The IDSA course did contain a helpful navigation bar which allowed the learner to see their progress, but the other two courses were designed in a linear fashion which meant each learner moved through the modules the same (once the learner decided upon the individual module).

The sixth element questioned whether the course elicited a performance throughout the course. The only course that had the learner perform in the middle of the module was the Medscape course. At the end of the fourth module, the learner was presented with two multiple-choice questions and could see how other participants responded previously. Due to the lack of elicited performances throughout the three

courses, the only type of feedback (seventh element) was provided at the end of the test questions. The feedback provided was usually scripted and the same response was used for multiple questions.

The final two elements involved the final performance assessments. Each course contained a final assessment, and with two of the three courses there were mandatory scores in order to obtain CME credit. The Medscape course allowed the learner to receive CME credit even though the learner did poorly on the post-test. By providing the CME credit, it showed that the participants could carelessly engage in the course without having to pay attention in order to pass the course. By having CME courses designed in this manner, the education of health care professionals will become less prestigious and reliable. There needs to be some form of accountability within CME interventions. In regard to assisting the learner with knowledge transfer, none of the three courses incorporated this event. Each course provided realistic examples, but the majority of the knowledge transfer was left up to the individual learner in how he/she could transfer the new information into their work environment.

The third and final matrix (Appendix B) was based on the principles and learning styles discussed in the Universal Design for Learning. The matrix served to evaluate whether the learners with a variety of learning styles, strengths, and weaknesses could participate easily and successfully with the course. The evaluator utilized the following questions in the evaluation matrix:

1. Did the course have multiple representations to satisfy multiple learning styles (text, graphics, audio, etc.)?

2. Did the course provide multiple ways for learners to express their knowledge?
3. Did the course incorporate opportunities for learners to interact with the course?
4. Did the course provide accommodations for physically handicapped learners to participate?
5. Did the course provide realistic situations and examples?
6. Did the course provide the learner with choices throughout the course?

The first Universal Design for Learning principle elicits multiple representations of the new subject material. The IDSA and BMJ Learning courses presented the material using mostly text. The IDSA course provided a few pictures, but the learner had to view the pictures by clicking on a link that would open up in a new window/tab. The figures also lacked captions, which could confuse learners and force them to flip between the course and photos in order to understand how the photos linked to the text. The BMJ Learning course only provided two figures while the remaining pages contained only text. Each page was filled with paragraph after paragraph with very little color.

The Medscape course provided the best example of using multiple representations to present the same content information. Each video presentation contained a clear video recording of a speaker discussing the presentation slides, which could also be seen on the screen. The course provided an audio element as well as visual elements. The visual elements allowed the learner to see the speaker discuss the subject as well as the slides as they were being discussed. The video could help learners who are not frequent online course users by making the course seem as if the participant was sitting in a classroom

listening to a live speaker. The presentation slides were also helpful. The slides contained colorful graphics, as well as minimal text, so as to not distract the learner from the speaker. One of the speakers created animations on the slides in order to focus the learner on the specific area being discussed at that time. The types of representation (audio and visual) helped the learner focus on the material, as well as stay on task throughout the course.

Expression and interaction are two of the important concepts within the second principle of the Universal Design for Learning. The three online courses allowed the learners to express themselves using one method only: multiple-choice answers. This limited method of expression can hinder the learning process. With the multiple choice question format, the learner did not have to apply the information in order to explain himself/herself. Instead, learners were only required to guess an answer from a list of choices. This provided learners with limited opportunities to interact with the course, other than to click on an answer during a test and to click the “next” or “previous” buttons.

The second Universal Design for Learning principle also questions whether designers provide accommodations for the physically handicapped. This information could not be found for any of the three courses. The only accommodation for the physically handicapped was the audio recordings provided in the Medscape course. Accommodations for the physically handicapped may not always be necessary depending on the target audience. However, in the CME interventions examined, it was not always provided.



The third Universal Design for Learning principle calls for designers to provide realistic examples and choices for the learners throughout the course. All three courses provided some amount of realistic examples using case studies and current research studies. These examples helped learners understand how the new information related to their current work environment. The IDSA course provided the greatest amount of choice (also included in the third principle) within the course. Learners in this course had to complete four of the six presented case studies in order to receive CME credit. They could complete the case studies in any order, which allowed for some form of choice. Once a case study was chosen the learners were also provided a navigation bar. Using the navigation bar, the learner could move sporadically through the case study as long as he/she completed each component. The BMJ Learning and Medscape courses also provided the learner with the opportunity to decide the order of the individual modules, but once they began the module he/she had to complete it the way the course was designed (in a linear fashion).

After completing the current evaluation of the three online CME courses, the following are recommendations by the researcher to be considered when designing future online CME interventions. It is important to note that these recommendations are based on the evaluation of three online CME courses out of many possible courses. There is potential that other current online CME courses are currently utilizing these recommendations.

Future online CME courses should:

1. *Administer Pre-tests.* These help learners recall prior knowledge as well as allow the course to be evaluated using Kirkpatrick's Level 2 evaluation.

By using a pre-test and a post-test, course evaluators can compare the two tests scores in order to show that the knowledge gain can be attributed to the educational intervention. Recalling prior knowledge can also help with motivation as the learner can see how close or how far he/she is from meeting the learning goal(s).

2. *Incorporate methods to gain attention.* Self-motivation is imperative for an online educational intervention. In order to motivate learners, designers should provide a way to grab and hold their attention throughout the course (Dukes & Scott, 2009, p. 39-40). If adults understand how the new information/course will benefit them in their immediate line of work, they will be more motivated to participate and work harder to understand the new material (Knowles et al., 2005). Learners also strive for achievement and are motivated to work towards achieving a goal. If the course can show how learners can achieve a new goal, learners will become more motivated to provide their undivided attention in order to reach their goal. (Gagné, 1985, pp.308-309). By gaining their attention in the beginning the learning process can be initiated as soon as the learner starts the course.
3. *Elicit performance throughout.* This instructional element is used in Gagné's nine events of instruction. If new material is chunked into smaller segments with a way of testing their knowledge after each segment, it will help learners to know their learning progress and whether they are grasping the new information before the final assessment. Self-

directed learning supports these ideas. It can be defined as “a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies and evaluating learning outcomes”

(Knowles, 1975, p. 18). Health care professionals partake in self-directed learning by taking control and ownership of their learning within CME interventions. By providing periodic opportunities to elicit performance, self-directed learners can monitor their learning progress more frequently. The more opportunities that are incorporated for eliciting performance, the more ways in which the designer can have the learner express themselves, which is an important concept within the second Universal Design for Learning principles (Center for Applied Special Technology, 2010).

4. *Enhance retention and transfer.* This can be accomplished by providing charts and figures with key points that are easy to remember after completing the course. It can also be accomplished by providing examples that are similar to what the learner will experience after the completion of the course. (Gagné, 1985, p. 315-316). If learners can understand and know how they will use the new information, they will be more motivated to learn the material (Knowles et al., 2005)
5. *Provide multiple ways to present the new material.* Eighty percent of the content the human brain processes is through visual representations. (Nokes & Sappington, 2010). For this reason, content representation is

important. Nokes and Sappington (2010) emphasize the importance of the amount of text per page in an online course. Each page should only include what the text that is considered absolutely necessary. To improve the appearance of each page, remove some of the text and incorporate more visuals such as graphics, charts, etc. Audio components that complement the visual elements are also helpful for auditory learners.

6. *Provide more opportunities for learners to interact with course.*

Providing interactions can allow learners to express themselves other than using written responses. If the online environment supports collaboration, multiple ways to elicit performance, etc. then the user will become more involved with the course and in turn this will help with retention and learning transfer (Center for Applied Special Technology, 2010; Davis et al.,1994).

The researcher used aspects of these recommendations when designing the Lyme disease online CME course for the present research study.

### **Summary**

Throughout Chapter II, the researcher examined literature on CME effectiveness, evaluation, learning theories, and instructional design. This chapter also provided the reader information on three current CME courses and the instructional design elements that were/were not used in each one. The literature has shown that didactic CME interventions can be just as effective as online CME interventions. However, the design of either intervention is imperative in order to gain an increase in knowledge, self-efficacy, and behavior. As seen in the conceptual frameworks (Figure 2.1 & Figure 2.2),

the researcher based her design decisions on the andragogy, social learning, and self-directed learning theories. The researcher also used interactivity, collaboration between colleagues, and other instructional design principles when designing the online CME course regarding Lyme disease. In the next chapter, the researcher will discuss the methods used in the present research study.

## **Chapter III. Methodology**

### **Research Design**

The current research study involved the design of an online Continuing Medical Education (CME) course on Lyme disease and examined how the course design affected health care professionals' self-efficacy and change in behavior. The purpose of this study was to gain a greater understanding of how interactive instructional elements affect the participants' self-efficacy and changes in behavior. As previously stated, the independent variable was the interactive elements included in the online CME course. The dependent variables were the degree of behavioral change and level of self-efficacy among participants. The study was reviewed and approved by the Institutional Review Board at James Madison University, and took place from October 2010 through April 2011.

The present study included an applied, mixed-methods research design using a randomized pretest-posttest control group (Fraenkel & Wallen, 2006). The researcher designed and developed two versions of the course before collecting data. The course designed for the experimental treatment included the use of interactive questions throughout the course modules and an interactive discussion board via Wikispaces<sup>®</sup>. The course designed for the control group did not involve the use of a discussion board or interactive questions. All other elements of the course were identical. The researcher utilized both quantitative and qualitative methods to obtain a thorough analysis. The researcher administered a survey containing Likert-scale questions to obtain quantitative data. After collecting the survey data, the researcher collected qualitative data via interviews in order to refine and expand upon the quantitative data. This explanatory, mixed-methods design provided the researcher with the opportunity to gather additional

information beyond the forced responses provided in the survey (Fraenkel & Wallen, 2006; Plano Clark, Creswell, Green, & Shope, 2008).

### **Participants**

Participants for the study were recruited throughout the United States. The researcher collaborated with contacts at the International Lyme and Associated Diseases Society (ILADS), James Madison University (JMU) Health Sciences faculty, and local physicians in the Shenandoah Valley to recruit health care professionals to participate in the study. During the recruiting process, the researcher collected email addresses to distribute the study via the Internet. Participants were assigned into a control group and an experimental group, using a random selection process. To assign people to a specific group, the researcher alphabetized the participant list and every other person was assigned to the experimental group. This method helped to eliminate researcher bias as well as maintain consistent group characteristics (Fraenkel & Wallen, 2006). Throughout the study, participants were unaware of their placement group.

The training was distributed via email to a total of 235 health care professionals. The researcher emailed a cover letter with the attached IRB-approved consent form (Appendix A). The number of participants in each group is illustrated in Table 3.1 (Experimental Group) and Table 3.2 (Control Group). Table 3.3 illustrates the total number of participants who received the final survey. The study had a response rate of 18%, which were lower than the reported 34.5% response rate by Crawford, Couper, and Lamias (2001) and 41% by Couper, Traugott, and Lamias (2001). Along with the response rate, the present study had a dropout rate of 43% between the beginning of the study (pre-test) and the end (final survey). The dropout rate was calculated by

subtracting the survey responses (24) from the pre-test responses (42) and dividing that number by the original number of participants (42).

Table 3.1

*The number of participants in the experimental group.*

	Pre-test	Post-test	Wikispaces <sup>®</sup> Participation
Distributed	115	115	115
Completed	18	14	Over 50 views – 2 posts

Table 3.2

*The number of participants in the control group.*

	Pre-test	Post-test
Distributed	120	120
Completed	24	22

Table 3.3

*The number of participants for the final survey.*

	Final Survey
Distributed	235
Completed	24



Even though 35 health care professionals began the survey, five participants opened the survey but did not answer any questions after the demographic questions. In addition to the five drop outs, six participants chose “No” on the first contingency question. This response caused the survey to end automatically. For the purposes of data analysis, 24 health care professionals completed the survey.

The final survey contained demographic questions to provide the general characteristics of the participants. Participants were between 21 and 65 years of age, with a mean age of 43. 74% of participants were female and 26% were male. Figure 3.1 portrays the various medical titles of the participants. Participants also had the choice of “other” when asked their medical title. These participants described themselves as Physician Assistants, students, and medical students.

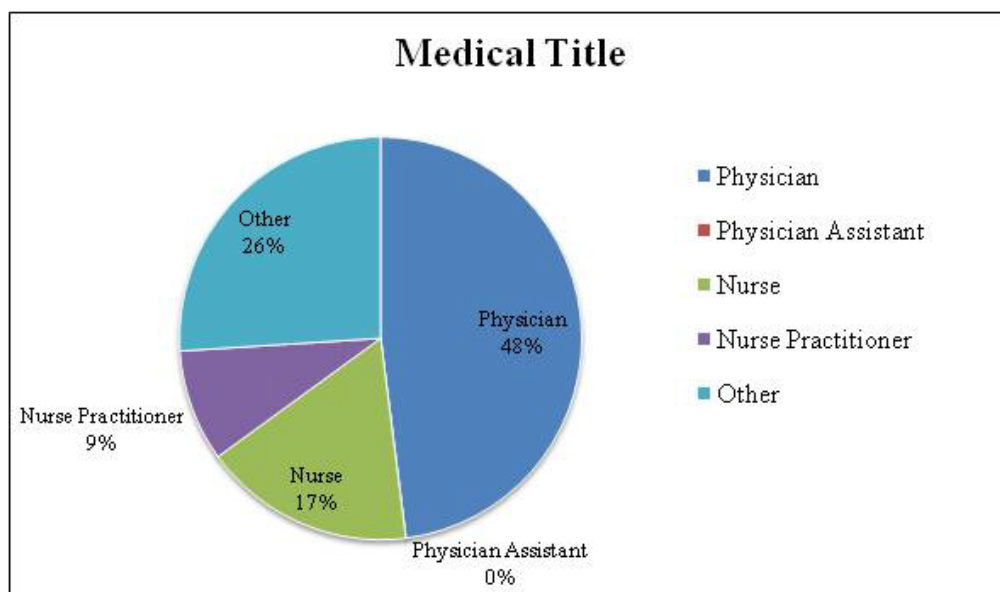
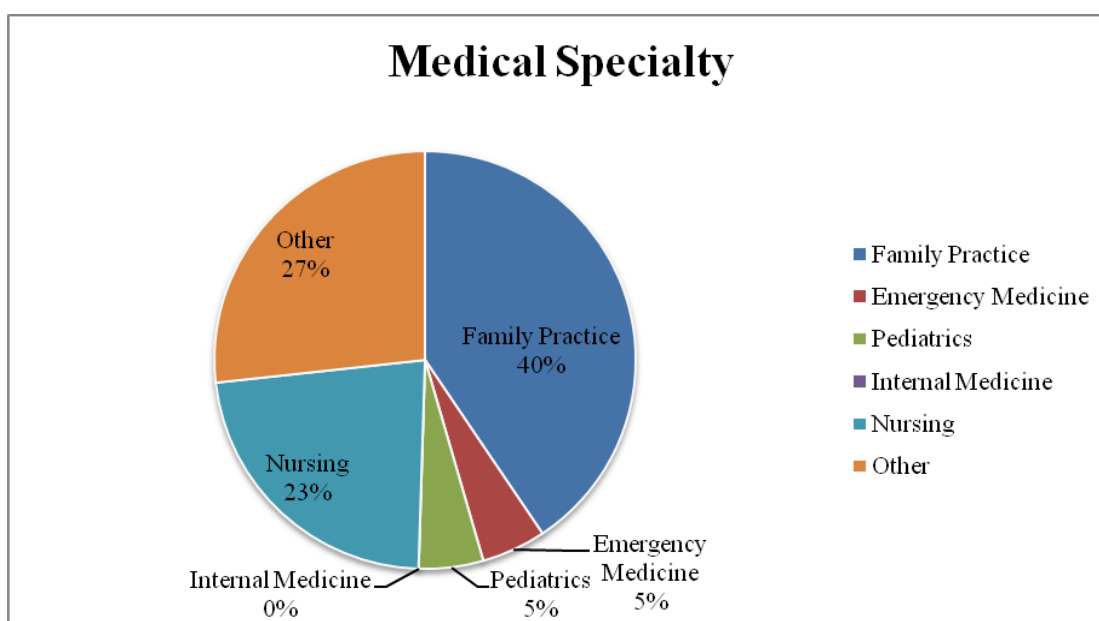


Figure 3.1. Medical Titles of Participants.

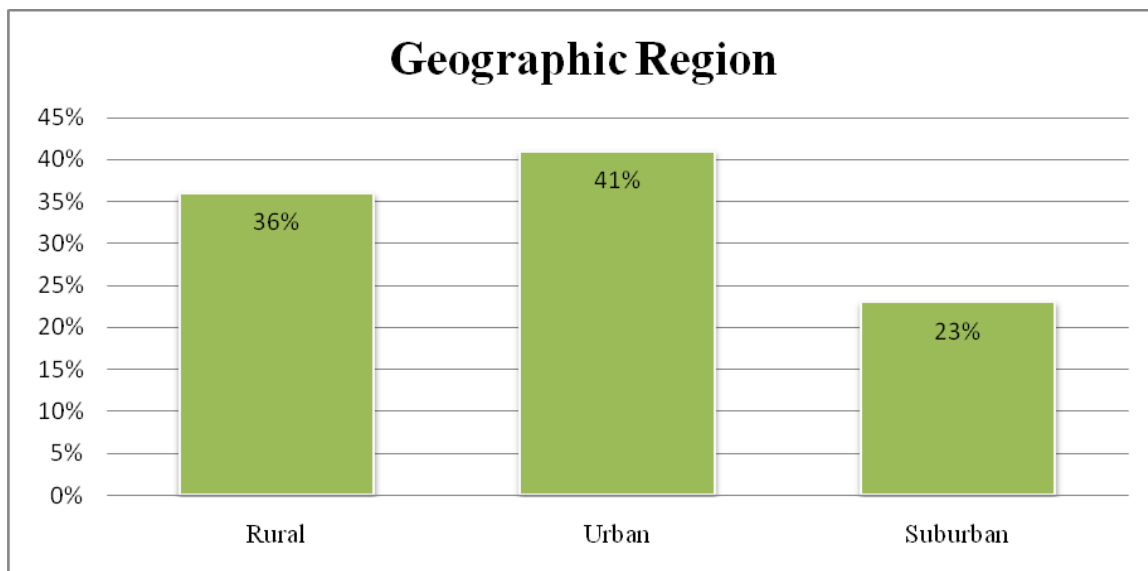
Along with participants' medical title, their medical specialty was also surveyed. Figure 3.2 illustrates the various medical specialties of participants. The most popular specialty was family practices comprising 40%. Participants also had the option of selecting "Other" if any of the forced answer responses did not apply. The "Other" category included medical students, functional medicine, and obstetrics/gynaecology.



*Figure 3.2.* Medical Specialty of Participants

Lyme disease has been diagnosed and found throughout the United States (Center for Disease Control, 2009). For this reason it is important for doctors within urban, rural, and suburban environments to have the ability to diagnose Lyme disease (Center for Disease Control, 2009). The researcher surveyed participants to understand the regions in which they practiced medicine. Figure 3.3 shows a mixed response with 36% practicing in a rural environment, 41% in an urban environment, and 23% in a suburban

environment. This illustrated a good distribution of participants within a variety of regions.



*Figure 3.3.* Regions in which participants practice medicine.

The present study served as a pilot study for a future CME course on Lyme disease. For the future course, each participant would receive official CME credit for his/her participation. In the study, the researcher had to provide other forms of motivation to increase participation in the course. The researcher used initial contact emails, email reminders, and personal contacts in order to increase participation (Cook, Health, & Thompson, 2008). A raffle was also set up in order to increase participation. The raffle prize included a video titled “Under Our Skin” (a video regarding the Lyme disease epidemic) and a book titled “Insights into Lyme Disease Treatment: 13 Lyme-Literate Health Care Practitioners Share Their Healing Strategies” (a book written by physicians regarding Lyme disease cases and treatment plans). These items were mailed to the participant once the study had been completed. This raffle was used solely as a

motivational technique to enhance participation. It was also explained to the participants on the raffle form that if they wished to be notified when the future CME course becomes accredited, then the CME provider will notify them using the information provided on the raffle form. Once each participant completed the final survey, he/she could complete the raffle form.

### **Role of Researcher**

Throughout this study, the researcher had multiple roles. Once the research design was chosen, the researcher became the instructional designer and producer of the online course to be tested. Throughout this process, the researcher worked closely with the Subject Matter Expert (SME) to ensure accuracy of the content. The design and development process will be explained throughout the remaining sections of this chapter. The final role of the researcher was to evaluate the online course to test for the present study's variables and to answer the research question.

### **Role of Subject Matter Expert**

Due to the lack of expertise regarding Lyme disease, the researcher partnered with a SME throughout the research process. The SME became involved with the project when presenting the idea of transforming the didactic presentation she conducted at conferences to an online format. The SME was a practicing physician who had conducted extensive research on the topic of Lyme disease. She also had a wealth of experience diagnosing and treating Lyme disease patients. The content of the two courses (one for the control group and one for the experimental group) created in the current study was developed by the SME, as well as the script used for the audio

recordings for each slide. Throughout the design process, the researcher prototyped each piece of the courses to obtain the SME's approval before proceeding.

### **Procedure**

The study utilized a control group and an experimental group in order to test for the independent variables. To begin the evaluation and experimentation analysis, the two online CME courses had to be designed. The researcher utilized the ADDIE framework to organize the methodology of the research study. The researcher had to complete each phase of the framework throughout the study. The following sections will detail the research process using the ADDIE framework (Analyze, Design, Develop, Implementation, Evaluation) discussed in Chapter II.

**Analyze.** The first phase of the ADDIE framework is the analysis phase. The primary component of this phase is the needs assessment of the target audience. The instructor must first analyze the characteristics of the audience, including their prior knowledge of the content. The next step is to determine the amount of content information that needs to be acquired by the end of the curriculum. When comparing the current level of knowledge of the target audience with the proposed level of knowledge, an analysis of the content information is necessary in order to understand how to effectively convey the information and allow the greatest amount of knowledge gain (Peterson, 2003).

All health care professionals are required to participate in some form of continuing education (American Medical Association, 2010; Stein, 1998). For this reason, the target audience for the courses used in this study was all health care professionals. Due to the variability of the possible audience, the amount of prior

knowledge was unknown to the researcher. When developing the content it was assumed that all participants had some amount of prior knowledge regarding Lyme disease.

**Design.** After reviewing the extensive amount of content used in the SME's didactic presentations, it was decided that the online CME course would need to be broken down into smaller courses. The current study was used as a pilot study for the overall design of the future online CME course for the SME. For that reason, the course used in this study was structured to be the first course in a Lyme disease course sequence. Once this decision was made, the amount of content reduced dramatically. The researcher worked closely with the SME to decide upon the goal and objectives for the introductory course. The overarching goal of the online course was as follows: To improve health care professionals' ability to recognize Lyme disease in a clinical setting. The objectives of the course were also listed and included:

- Identify and compare the symptoms of Early Localized, Early Disseminated, and Late Lyme disease
- Recognize Lyme disease cases based on the patient history and symptoms
- Feel confident in his/her ability to diagnose Lyme disease on a clinical basis.

By identifying the overall goal and objectives, the researcher could decide which elements of the didactic presentation should be utilized.

After analyzing the target audience and content, the researcher made decisions regarding the design of the two courses. The researcher decided which instructional elements to include in the course design. As the researcher examined a variety of courses, she kept a record of the instructional components she hypothesized would be the most effective for learners. As discussed in Chapter II, the researcher also completed a

thorough evaluation of three online courses that had content similar to the present study's content. The researcher noted the instructional components that were personally helpful to her in her own experiences with online instruction. After analyzing multiple aspects of current CME design, the researcher had evaluated multiple current CME online courses, reviewed the research found in Chapter II, and had decided upon the instructional elements to be included in the experimental and control version of the study's online CME course. These components are organized in Table 3.4.

Table 3.4

*Instructional Components within Online CME Courses*



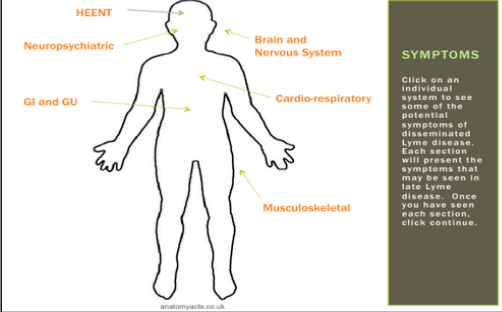
Instructional Components within Experimental Group	Instructional Components within Control Group
Graphics	Graphics
Videos	Videos
Case Studies	Case Studies
Pre- and Post-tests	Pre- and Post-tests
Interactive questions throughout the online instructional modules including feedback with each answer choice	
Interactive buttons which allowed the learners to decide the learning path	
Collaborative Online Discussion Board	
Visual elements to highlight text as audio covers specific material.	

The pre- and post-tests, graphics, and the videos within the course modules were identical for both groups. However, the case studies were presented using videos in the experimental group. The control group's case studies were presented using only text.

Once the researcher had decided upon the components to be included in the experimental course, the design of the instructional modules began. The use of storyboards has become a popular organizational tool for learning objects and web-based instructional interventions (Mustaro, Silveira, Omar & Stump, 2007; Vaughan, 2008). Storyboards are used to describe basic and intricate details to the client and design team. Due to the multiple components of the current study, storyboarding the course was important (Figure 3.4). By doing so, the SME and the researcher could decide upon the exact layout of the course before expending time in the development phase.

Another part of the design phase was to decide upon the “look and feel” of the course, as well as how the content would be presented. When creating computer or web-based modules, the overall theme needed to be consistent (Khan, 2001). The use of storyboards ensured consistency throughout course development. The researcher completed a storyboard for the online course modules and also for the webpage, which housed each module. It was important that the color scheme, font type, and overall layout remained similar throughout each component of the study. The size of files used within the course also had to be considered. For example, accommodations were made when creating the online discussion board. The original video containing two case studies was broken into two different videos. The instructional portions of the course were also divided into smaller modules due to the large file size of the original didactic presentation of the SME (Khan, 2001).



<div data-bbox="337 254 808 611"> <h3 style="text-align: center;">DIRECTIONS</h3> <p>You have now completed step 1 of 4 for this CME course. Now you are entering the instructional portion of the course. As you move through the course, there will be questions to guide your learning as well as directions to complete assignments. There will also be directions for completing the next step in the course at the end.</p> <p style="text-align: center;">Press the START button to begin!</p> <div style="text-align: center;">  </div> </div> <p data-bbox="293 638 841 716">You have now completed step 1 of 4 for this CME course. Now you are beginning the instructional portion of the course. As you move through the course, there will be questions to guide your learning as well as directions to complete assignments. There will also be directions for completing the next step in the course at the end.</p>	<div data-bbox="930 254 1395 541"> </div> <p data-bbox="889 562 1435 716">Many people mistakenly believe that Lyme disease is found in New England only. On the contrary, Lyme disease cases have been found throughout the United States. Over 35,000 cases of Lyme disease are reported annually within the United States. By some estimates, this number is only a fraction of the actual number of cases contracted each year. The discrepancy between the number of cases reported and the actual number is largely due to three components. The first is the variability of the symptoms, which make the disease difficult to diagnose, and unreliable testing. As can be seen on the map, higher concentrations of reported cases may be found in the New England and mid-Atlantic states, around the Great Lakes, and in the Pacific Northwest.</p>
<div data-bbox="342 779 797 1115"> <p data-bbox="375 793 651 890">What are the two most common ticks found in the US that can spread Lyme disease?</p> <ol data-bbox="375 898 651 1079" style="list-style-type: none"> <li>Eastern Black-legged and Western black-legged</li> <li>Easter Black-legged and dog tick</li> <li>Easter Black-legged and Lonestar tick</li> <li>Dog tick and Lonestar tick</li> </ol> <div data-bbox="695 835 792 940" style="background-color: #92d050; padding: 5px;"> <p><b>HOW MUCH DO YOU KNOW?</b> Answer the following question to the best of your ability.</p> </div> </div> <p data-bbox="305 1146 829 1182">Before we get started: How much do you know about the types of ticks that transmit Lyme disease? Select the answer that you think is correct.</p>	<div data-bbox="911 779 1403 1178">  <p data-bbox="1300 863 1377 953"><b>CORRECT!</b> Great Job! Let's find out more about these ticks.</p> </div>
<div data-bbox="337 1247 829 1612"> <h3 style="text-align: center;">TISSUE DISSEMINATION</h3> <ul style="list-style-type: none"> <li>■ Add Betty's Video</li> <li>■ Expanding (EM) rash signifies Bb has migrated within the dermis</li> </ul> </div> <p data-bbox="293 1646 850 1682">As <i>B. burgdorferi</i> migrates through the dermis, it may cause an expanding EM rash. Recall that 30% of patients never had an EM.</p>	<div data-bbox="927 1247 1425 1556">  <div data-bbox="1317 1289 1409 1478" style="background-color: #92d050; padding: 5px;"> <p><b>SYMPTOMS</b></p> <p>Click on an individual system to see some of the potential symptoms of disseminated Lyme disease. Each section will present the symptoms that may be seen in late Lyme disease. Once you have seen each section, click continue.</p> </div> </div> <p data-bbox="883 1583 1435 1619">The symptoms of Late Lyme can involve any body system or organ. Click on each section and we will discuss the symptoms.</p> <p data-bbox="883 1646 1414 1682">They will be able to click on the part they want to see once it is uploaded into Captivate. None of the links work right now in PowerPoint.</p>

*Figure 3.4.* Sample Storyboards used throughout the course design. More can be found in Appendix C. These six items within the figure represent sample storyboards used in the course design. The words below each figure represent the audio script that corresponds to each slide.

The original, didactic version of the course utilized a presenter (the SME) and PowerPoint<sup>®</sup> slides. To organize the content of the course, the researcher used Microsoft PowerPoint<sup>®</sup>, reorganized the information, and added a new color scheme (See Figure 8). When organizing the content of the PowerPoint<sup>®</sup> slides, the researcher utilized multiple learning theories and techniques suggested in Chapter II (Bandura, 1986; Gagné, 1985; Knowles, 1975; Knowles et al., 2005; Rose & Meyer, 2002). Once the content was organized and the overall layout design was finalized, the researcher sent the prototype (storyboards) to the SME for approval. The SME corrected the content slides, provided feedback regarding the overall format, and wrote the script to be used as a voiceover by the researcher on multiple slides. After multiple rounds of feedback and improvements, the slides were uploaded into Adobe Captivate<sup>®</sup>, the software used during distribution.

**Development.** When moving forward to develop the course components, the researcher created the pre-test and post-test first. Both tests were created using the survey design software, Qualtrics<sup>™</sup>. The first section of the pre-test included a case study regarding a patient with Lyme disease symptoms. The case study was followed by four questions (multiple choice, ordering, true/false). The second section of the pre-test included three dichotomous questions and one multiple-choice question regarding general Lyme disease information. This survey enabled the researcher to gather data on each participant's current level of knowledge regarding Lyme disease.

The post-test comprised a different case study, but contained the same question format following the case study. The second section of the post-test also included the same three dichotomous questions and one multiple-choice question. This instrument allowed the researcher to compare the scores of each test (pre and post) in order to

analyze the amount of knowledge gained directly after participating in the instructional modules.

The researcher utilized several design principles when creating the pre-and post-test instruments. These principles were used to help reduce abandonment of the instruments as well as increase the effectiveness. The researcher included properly spaced questions, a progress bar, and had clear directions (Couper, 2000; Fraenkel & Wallen, 2006; Umbach, 2004). The content of the pre-and post-tests was created by the SME. To ensure validity of the instruments, both pre- and post-tests were approved by the SME, the researcher's thesis chairperson and other colleagues. To project an accurate time for each participant to complete the survey instruments, the researcher had four colleagues pilot the pre- and post-tests and report the amount of time it took to complete the instrument.

Once the assessment instruments for each course were designed, the storyboarded slides were also ready to be developed using a course creation software application. The Adobe Captivate<sup>®</sup> software allowed the researcher to record audio for each slide, add interactive elements, and include question slides to guide the learners through the process. One of the most difficult challenges for the researcher was the pronunciation of the vast number of medical terms within the script. To grasp the correct pronunciations, the researcher utilized the help of the SME, via the telephone, and other nursing students.

Interactive components within online training can be considered one of the most important instructional activities (Khan, 2001). The interactive components used in the experimental group's online course included multiple-choice questions, action buttons (used to allow learners to navigate through the course at their own pace and decide some

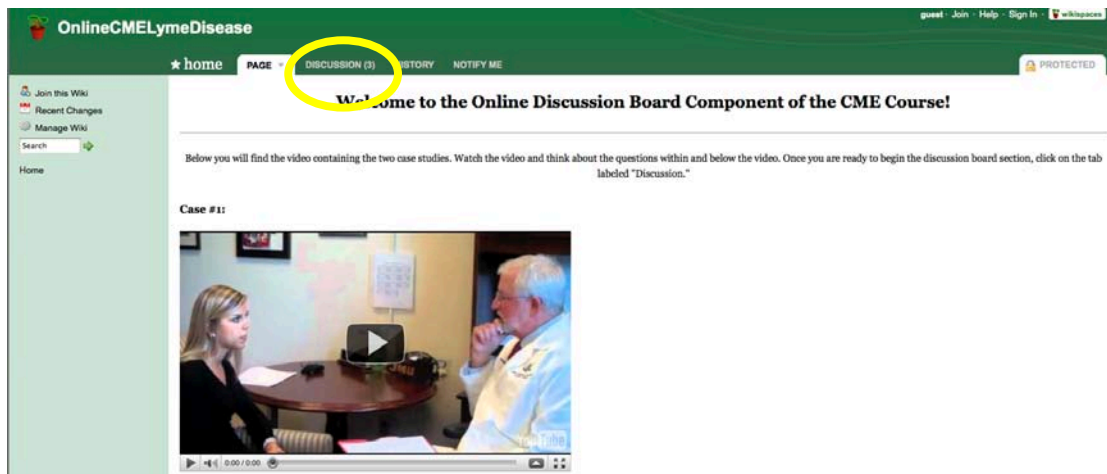
of the order of the content), and an online discussion board component. Screen shot examples of the interactive components can be found in Figure 3.5. Once the researcher added the instructional components and recorded the audio, the course was sent back to the SME for revisions. After numerous revision cycles, the audio and instructional modules were approved.

The figure displays six screenshots from an Adobe Captivate module titled "DIAGNOSING LYME DISEASE".

- Slide 1:** Title slide "DIAGNOSING LYME DISEASE". It includes a welcome message, course details (Online CME Course), content by Elizabeth Maloney, MD, and produced by Monica Blackwell.
- Slide 2:** "Reported Cases of Lyme Disease -- United States, 2009". It features a map of the United States with highlighted areas in the Northeast, Midwest, and West Coast. A sidebar lists "HISTORICAL FACTS" stating over 35,000 cases were reported in 2009.
- Slide 3:** "TRUE OR FALSE?" quiz. It asks three questions:
  - Lyme disease is only reported in the Northeastern United States. (True/False)
  - If a patient does not have a rash that resembles a bull's-eye on their body, then they do not have Lyme disease. (True/False)
  - With standard therapy, all Lyme disease patients are cured. (True/False)
- Slide 4:** A human silhouette diagram with labels for various symptom systems: HEENT, Neuropsychiatric, GI and GU, Brain and Nervous System, Cardio-respiratory, and Musculoskeletal. A sidebar titled "SYMPTOMS" explains that clicking on a system will reveal potential symptoms of disseminated Lyme disease.
- Slide 5:** "HEENT" symptoms: Tinnitus, Decreased hearing (Unilateral sensorineural loss), Hyperacusis, Auditory hallucinations. Includes an anatomical diagram of the ear.
- Slide 6:** "MUSCULOSKELETAL" symptoms: Bone or joint pain, Joint swelling, redness, warmth, stiffness, Myalgia, muscle spasms or cramps, Over-use syndromes (Carpal tunnel syndrome, Tendonitis, Bursitis, Tennis elbow). Includes a photograph of a person holding their lower back in pain.

Figure 3.5. Screen shots taken from the Adobe Captivate<sup>®</sup> modules.

The next step in creating the experimental version was to develop the online discussion board component (Figure 3.6). The use of communication between learners can be an effective online course instructional tool (Khan, 2001; Boulos et al., 2006). The online discussion board included two videos with case studies regarding possible Lyme disease patients. Due to the researcher's short timeline to design all the course components, the researcher utilized a team of undergraduates within the Human Resource Development program to assist with the design of the online discussion board components. The team consisted of four undergraduate students currently enrolled in the Human Resource Development minor at JMU. The two videos utilized realistic case studies that prompted participants to apply the new content to the case study contents. When using case studies in an instructional intervention, it is important that the case contents align with the overall learning goals of the intervention (Khan, 2001). The SME helped develop the objectives and assessments, as well as the case studies within each course. This helped to ensure the case studies and corresponding questions aligned with the learning goals.



*Figure 3.6.* A screen shot of the Wikispaces<sup>®</sup> website. Participants in the experimental group were asked to watch the videos on the first page seen here and then post on the discussion board on the “discussion tab.”

Once the experimental group was completed, the control group’s modules could be created. To do so, the researcher made an exact copy of the experimental group’s modules and removed the interactive components. By modifying the exact version of the experimental group, the audio consistency and accuracy, the slide content, and layouts would remain the same for both groups. The only module that had to be recreated was the final module. The experimental group’s module provided the learner with directions on how to access the Wikispaces<sup>®</sup> online discussion board. The control group’s final module contained the same case studies, but in a text-only version. Instead of having the opportunity to collaborate with other participants regarding the case studies, the control group participants were provided rhetorical questions that asked them to think about various aspects of each case.

The organization of both versions of the online course was primarily based on Gagné's nine events of instruction, which was explained in Chapter II (p. 30). When designing instruction, the target audience is an important factor. With Gagné's nine events of instruction, adult learners are likely to have established some of the events on their own. For this reason, the researcher was not required to use all components or create instruction in the exact order of Gagné's model. However, not all adult learners have the same abilities meaning that it is important to incorporate as many instructional events as possible into a curriculum (Gagné, 1985).

The first element in the course was the pre-test, which does not coincide with Gagné's first event of instruction. The researcher had participants complete the pre-test first in order to ensure a smooth transition within course components. If the pre-test was included in the first module, the participant could have found it difficult to navigate back to his/her place in the module. For this reason, the pre-test was the first link on the course webpage. However, the remaining sections of the course did follow the other nine events.

After the pre-test, the researcher gained the attention of the learner and provided the learning objectives (the first two events). Once the learners understood the objectives, the level of prior knowledge, and were motivated to learn more Lyme disease information, the researcher began presenting the new content information (fourth event). Throughout the course, the researcher provided learner guidance (fifth event) by highlighting important information during the audio readings as well as elicited performance (sixth event) using the interactive questions. After each learner responded to the questions, feedback was provided (seventh event) to explain the answer. After

presenting all of the new content material for the course, the researcher asked each learner to complete a post-test (eighth event). Within the final instructional module and on the post-test, there were realistic case studies written by the SME. These case studies, as well as the questions that followed, helped learners understand how to transfer (ninth event) the new information into their daily practice.

The final step in the development stage was to organize the components of the courses onto a webpage (Figure 3.7). The webpage provided participants with one course link to refer to throughout their participation. The webpage consisted of links to the pre-test, instructional modules, the online Wikispaces<sup>®</sup> (for the experimental group), and the post-test. The webpage was designed using the free, webpage designer software program, SeaMonkey<sup>®</sup>. The researcher used the same color scheme and overall “look and feel” to keep all components consistent. Once finalized, the webpages were uploaded onto JMU’s College of Education’s server for distribution.

**Diagnosing Lyme Disease**  
**Online CME Course**

Welcome to this online CME course regarding Lyme disease! Below you will find all of the course components. Please complete each step including the pre-test, 6 instructional modules, the online discussion, and the post test.

Please complete all components IN ORDER!! However, you may complete them at your own pace. (You may need to bookmark this website or keep your initial email to return to the course once you close the browser.)

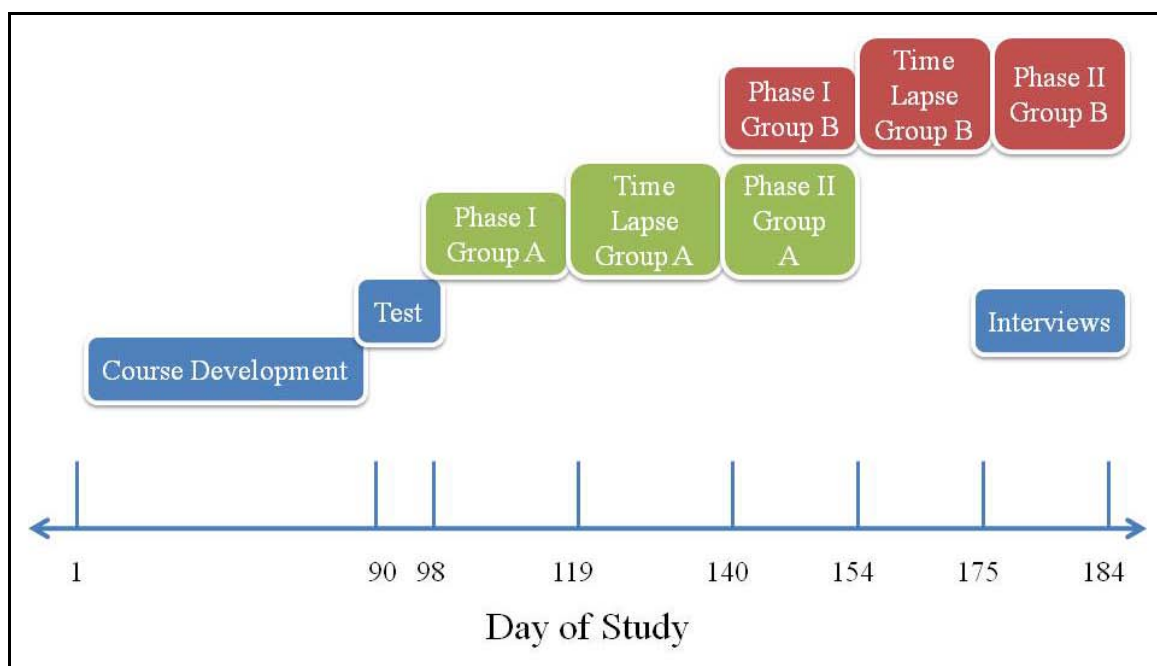
<p><b>1. Pre-Test</b> This module will direct you to the pre-test survey.</p>	<p><b>2. Introduction and Pathophysiology</b> This module will cover Lyme disease basics as well as the pathophysiology of the disease.</p>
<p><b>3. Borrelia Burgdorferi</b> This module will cover the Borrelia bacterium and how it affects the body.</p>	<p><b>4. Clinical Presentation</b> This module will cover the various aspects of the clinical presentation of Lyme disease.</p>
<p><b>5. Symptoms</b> This module will cover the symptoms of Lyme disease.</p>	<p><b>6. Physical Exam</b> This module will cover the necessary components of a physical exam of a Lyme disease patient.</p>
<p><b>7. Conclusion</b> This module will provide instructions on how to access and complete the online discussion board.</p>	<p><b>8. Wikispace Online Discussion</b> This module will connect you to the online discussion board.</p>
<p><b>9. Post-Test</b> This module will direct you to the post-test survey.</p>	<p><b>10. Final Survey</b> This will be the final component of this course. The survey will be emailed to you within three weeks of completing the other components found on this website.</p>

Figure 3.7. The webpage used to distribute the training components.



**Implementation.** The fourth step in carrying out this study was to implement the two courses. This process was divided into two phases. Once the researcher had designed the components for the study, she compiled each group's components onto one webpage per group for easier access. During Phase I, the participants were sent a cover letter via email which contained information regarding the study, as well as the IRB-approved consent form. By clicking on the hyperlink, each participant gave his/her consent to participate in the study and was redirected to the study's webpage. The control group and the experimental group had identical cover letters with the exception of a different hyperlink at the bottom. Phase I components for both the control and experimental groups included the pre-test, seven self-directed, instructional modules, and the post-test. The experimental group was asked to complete an additional module which included an online discussion board forum. There was a three-week time lapse between Phase I and Phase II. Phase II consisted of a final survey which will be discussed in the Evaluation section as well as interviews with four participants.

The overall time frame of the study is depicted in Figure 3.8.



*Figure 3.8.* Timeline of Study

As the figure portrays, the study took 184 days to complete in its entirety. The first 89 days were used to create the online courses and other study components, which was followed by an additional eight days used for testing the course components. All components were tested using multiple computers with both Mac and Windows operating systems. The researcher tested each component on computers of all versions using different Internet platforms including Safari<sup>®</sup>, Firefox<sup>®</sup>, and Internet Explorer<sup>®</sup>. Testing was completed thoroughly in an attempt to reduce the number of possible technical errors from the participants, which could have discouraged them from participating.

The distribution of the training took place within two different time frames. The first distribution, Group A, was sent to local physicians and the contacts made within the ILADS group. The JMU students participating in the study, Group B, were on winter

break during the first distribution. For that reason, Group B participated in the study at a later time compared to Group A.

Due to scheduling circumstances, the timings of the two protocols were slightly different. Each group was given at least two weeks to complete the pre-test, post-test, and instructional modules, three weeks between the two phases, and at least ten days to complete the final survey. The first round of distribution took place over the December holidays. The researcher provided Group A twenty-one days to complete Phase I in an attempt to increase participation and level out the numbers between the pre-test and post-test participants. Group B was only provided 10 days to complete Phase II (the final survey) due to JMU's Spring Break schedule. For the sake of data analysis, both distribution groups would remain in the same data set, which means there will be one experimental and one control group data set.

**Evaluation.** Phase II of the research study included the evaluation of the developed online CME courses. This study was used as a pilot study for a future online CME course regarding Lyme disease. In order to improve the course, the pilot course needed to be evaluated regarding the technical and instructional components (Khan, 2001). The researcher utilized Kirkpatrick's (1959a, 1959b, 1960a, 1960b, 2006) levels of evaluation discussed in Chapter II. Level 1, reaction, was assessed using the final survey. The researcher analyzed these results by conducting a question-by-question analysis. Level 2, learning, was assessed using the pre-test and post-test results. The researcher will compare the test results using descriptive statistics and a T-test. The third level of Kirkpatrick's framework, behavior, was assessed using questions within the final survey. The researcher also assessed the participants' levels of self-efficacy to see if

there was any correlation between participants' behavior and levels of confidence.

Although Kirkpatrick had four levels in his evaluation framework, evaluating the fourth level was beyond the scope of the present research study.

The design of the pre- and post-tests was discussed earlier in this chapter. The main instrument used for evaluation was the final survey, which was given three weeks after participants completed the online CME courses. The final survey was also created using Qualtrics™. By having participants complete a final survey, the researcher could gather data from a large number of people at one time (Fraenkel & Wallen, 2006). The researcher originally drafted all of the content within the survey questions. Once drafted, the researcher participated in multiple rounds of editing with the SME and the researcher's thesis adviser.


Questions included in the survey contained a majority of structured response questions with the exception of one unstructured response question for the experimental group. The survey opened with a welcome page thanking the participant for completing not only the survey, but also the entire study. A welcome message describing the purpose of the study and survey helped to motivate participants to complete the study. The welcome message provided the estimated time it should take the participant to complete the survey. This message also reminded participants of the anonymity of their survey responses. The researcher designed the survey to include a welcome message and began the survey with non-threatening questions in hopes that the participants would not feel threatened or intimidated by the survey, which would have prevented them from wanting to continue (Couper 2000; Fraenkel & Wallen, 2006; Trochim, 2000; Umbach, 2004).

The survey questions began with a contingency question, which asked participants if they completed the online CME course regarding Lyme disease. This question was necessary due to the distribution method. The researcher did not know the identity of the participants or which participants in the distribution list completed the study. Therefore, the researcher had to email all possible participants the survey and eliminate those who did not complete the course. If the participant stated they did not complete the online CME course, the survey ended immediately.

If the participant did indicate that he or she had completed the course, the next seven questions were demographic questions. These questions asked general information including: gender, age, medical title, medical specialty, type of workplace, geographical region of workplace, and Internet access. Results of the demographic questions were covered earlier in this chapter (p. 74). The next section questioned participants on their level of self-efficacy regarding the course content. The self-efficacy question utilized a four-point scale (Figure 3.9). This question addressed the dependent variable, self-efficacy.

Based on what you learned from the content of the CME course regarding Lyme disease, how confident are you regarding the following categories?

	Less Confident	Unchanged	More Confident	Very Confident
Making a clinical diagnosis of a patient with Lyme disease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identifying symptoms that could be related to Lyme disease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recognizing various types of EM rashes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding the difference between localized and disseminated Lyme disease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Describing clinical characteristics of Lyme disease to colleagues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0%  100%


>>

Figure 3.9. Survey question regarding self-efficacy.

The fourth section of the survey questioned participants on their behaviors regarding the course content, the other dependent variable. The first question of this section (Figure 3.10) asked participants how many times during the three-week period they completed a list of actions.

During the three week period between the completion of the CME course and this survey, how often did you perform the following actions:

- See a patient with an insect/tick bite.
- Discuss Lyme disease with a patient.
- Diagnose a patient with Lyme disease.
- Refer a patient to a Lyme specialist.
- Refer to the online training module.
- Refer to the information you gained by completing the online course.
- Refer to the case studies found in the online training module.
- Refer to the online Wikispace® discussion blog.
- Refer to other web-based information regarding Lyme disease.
- Collaborate with colleagues experienced in diagnosing Lyme disease.

0%  100%

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Figure 3.10. Survey question regarding behavior.

The second question in this section (Figure 3.11) asked participants to rate their change in behavior regarding a list of actions.

Based on what you learned from the Lyme disease CME course, how would you rate your change in the following behaviors?

	Unchanged	Changed Slightly	Changed Greatly
Discussing Lyme disease with patients.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recognizing symptoms that could be considered Lyme disease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Asking additional questions regarding symptoms to consider Lyme disease as a possible diagnosis.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diagnosing patients with Lyme disease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Referring patients to Lyme specialists.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0%  100%

>>

Figure 3.11. Survey question regarding change in behavior.

The participants were asked to rate these actions using a three-point scale as seen in Figure 3.11. This section allowed the researcher to see if the health care professionals applied the new information to their current medical practice.

The fifth section of the survey was specifically for the experimental group. To identify who was in the experimental group, a contingency question format was again used. The question pertained to the online discussion using Wikispaces<sup>®</sup> (which was not included in the control group). In order to have only participants in the experimental group complete these questions, the first question asks whether they participated in the online discussion. If the participant answered “no,” then the survey skipped to the next

relevant question. If the participants answered “yes,” the survey asked if they posted a comment on the discussion board (and if not, why) and how many times they posted comments. By having the next question (which depended on the participant’s response) appear on the next page, it kept the flow of the survey consistent (Trochim, 2000).

The final section of the survey contained an ordinal question. This question provided the components for each group (experimental and control) that were included in that section of the online course. The survey asked participants to rank the components according to what he/she found the most helpful throughout the online course. For the control group, the components included: the pre-test, the informational content within the online training modules, the cases found within the online training modules, and the post-test. The experimental group question included: the pre-test, the informational content within the online training modules, the interactive questions within the online training modules, the online Wikispaces<sup>®</sup> discussion, and the post-test.

The validity of the final survey was important. The researcher utilized similar design principles from the pre- and post-test instruments. The survey contained closed-ended questions in order to calculate the results faster and reduce the overall time for each participant to complete the survey. However, close-ended questions can be difficult to write and can be confusing if not constructed carefully. Previous research suggests keeping the questions as short, simple and focused as possible, using a common language among all participants (Fraenkel & Wallen, 2006; Umbach, 2004).

The overall format and design was also important. The researcher made sure the questions were spread out so as to prevent the participant from being overwhelmed. The survey also included a progress bar. The SME, as well as the researcher’s thesis adviser



and other colleagues, edited the survey to help decrease the chance of wording issues within each question. By having other experts examine the instrument multiple times, the content-related validity of the research was established (Fraenkel & Wallen, 2006; Couper, 2000).

The qualitative portion of the study consisted of four semi-structured interviews. One interviewee participated in the control group, while the other two interviewees participated in the experimental group. Due to the current location of each interviewee, the interviews were conducted via the telephone. To maintain consistency in the interview protocol, the research completed the steps below for each interview:

1. The researcher contacted the participant via email to ask for volunteers to hold an interview. The email also contained a consent form explaining the interview process (Appendix E).
2. The participant decided whether to continue with the interview. If so, they emailed the researcher their availability.
3. The researcher worked with each participant to set up a convenient time to hold each interview.
4. The researcher held the interview either face to face or via the telephone depending on the location and availability of each participant.
5. During the interview the researcher asked the interview questions and took notes on each participant's response.
6. After the interview, the researcher would email the interview notes to the interviewee for their approval. At this time, the interviewee could make any necessary corrections or send the researcher an email approving the notes.

7. The researcher then stripped all the identifying data and analyzed each interview.

By conducting telephone interviews, it saved the researcher and the participant time and money (Fraenkel & Wallen, 2006).

The interview questions were semi-structured and taken directly from the survey instrument. By asking the questions from the survey, the researcher could continue to gather information regarding the variables by allowing the interviewee to expand his/her thoughts beyond the forced multiple-choice answer choices (Fraenkel & Wallen, 2006).

The interview notes for each interviewee can be found in Appendix F.

### **Data Analysis**

As previously mentioned, the researcher used a mixed-methods design for this study. This method was used for several reasons. The quantitative data collected via survey and pre-and post tests allowed the researcher to collect data from a large number of participants at the same time. The qualitative data was collected due to the small sample size and to “better understand the problem being studied” (Plano Clark et al., 2008, p. 365). With both collection methods, the results must be analyzed.

The quantitative data was analyzed using the Qualtrics™ software as well as the SPSS® statistical analysis software program. The researcher compared the scores from the pre-and post-tests in a general manner by comparing the control and experimental groups as a whole. Statistical analysis included descriptive statistics and frequency of responses. Originally, the researcher planned to conduct a t-test to compare post-test means for the control and experimental groups. However, this test was not possible due to the methods used during data collection. To maintain anonymity, the researcher

masked the identity of the participants throughout the assessments. By doing so, the researcher could not match the pre-test and post-test scores for each participant in order to complete the planned t-test.

The qualitative data collected via interviews was compared in order to find common themes among the interviewee responses. In order to maintain the anonymity of the interviewees, the researcher stripped all identifying information before comparing and analyzing the qualitative data. The researcher compared the responses provided in each interview to the statistics gathered from the quantitative data. These responses were used to support the quantitative data. Any and all data collected during the research process was stored on a password protected hard drive and was accessible to only the researcher. In order to protect the identity of the participants, the data from the research study was destroyed at the completion of the study.

### **Threats to Internal Validity**

Due to the design of the research study and the outcomes of the groups of participants, threats to internal validity were evident. The current study incorporated history and mortality internal validity threats (Campbell & Stanley, 1963). A threat to the history between the pre-test, post-test, and final survey could not be prevented due to the variety of the locations in which the participants were recruited. The researcher did not know the specific patients each health care professional saw throughout the study. For this reason, the types of activities and instances that could have occurred for each participant was not known, which could have caused the results of the final survey or pre- and post-test instruments to be invalid.

Mortality was a large threat to validity within the current study. If participants decided to drop out of the study, the numbers of experimental and control group participants would be altered. This phenomenon is not uncommon in questionnaire studies, and it had a high potential to occur in this study (Couper, 2000; Fraenkel & Wallen, 2006; Umbach, 2004). To motivate participants to begin the study, the researcher offered two prizes that would be awarded to two participants who completed all components within the study.

It was also vital for the researcher to design the study components in such a way to prevent mortality throughout the study. Each survey instrument was designed to help reduce the non-response rate. Questions were closed-ended, spread out, and a progress bar was used to help prevent participants from ending the instruments and/or study early (Fraenkel & Wallen, 2006; Couper, 2000). During the implementation of the pre-test, modules, and post-test, the researcher provided at least two weeks to complete the components. The researcher also sent out email reminders regarding important deadlines. The same methods were used during the distribution of the final survey. By providing ample time to complete the study and sending out email reminders, the researcher attempted to decrease the chances of participants not completing all of the study components (Cook et al., 2008; Crawford et al., 2001; Muñoz-Leiva, Sánchez-Fernández, Montoro-Ríos & Ibáñez-Zapata, 2010).

**Summary**

This chapter detailed how the researcher completed the study, as well as the rationale for developing the treatment courses and how she evaluated the interventions. Chapter III also included information regarding the sample, role of the researcher and Subject Matter Expert, and how the data would be collected and analyzed. Chapter IV will further explain the analysis of the data and results.

## **Chapter IV. Data Collection**

The present study was conducted to investigate whether interactive elements within an online Continuing Medical Education (CME) course affected participants' self-efficacy and change in behavior. Prior to the study, the researcher designed and developed an online CME course. To evaluate the course, the researcher used both quantitative and qualitative data collection methods. The study began with a pre-test and concluded with a final survey of the study participants. The quantitative data were gathered using Qualtrics™ and the researcher conducted four interviews to gather the qualitative data. The following sections will illustrate the analysis of both the quantitative and qualitative data.

### **Quantitative Data**

**Pre-Test/Post-Test Results.** Both the control and experimental groups began the study by completing a pre-test. The pre-test was distributed to 235 participants with 42 health care professionals completing the test. The post-test was distributed to 235 participants and 36 completed the test. Both tests were distributed via Qualtrics™ and could be found on the study's webpage. Both tests contained similar questions, but used different case studies. The details concerning the overall design of the pre- and post-tests can be found in Chapter III. The results of the two tests were compared to identify any gain in participants' knowledge.

Each participant could achieve a total score of 13 points on both the pre- and post-tests. The first question on the pre- and post-tests asked participants whether symptoms presented in the case study could be consistent with Lyme disease. The pre-test provided four possible symptoms and the post-test provided seven possible symptoms. Table 4.1

shows the mean scores and standard deviation for the first question on the pre-test and the first question on the post-test.

Table 4.1

*The first question on the Pre-test and Post-test Mean Comparisons*

	Pre-test #1 (highest possible score = 4)	Post-test #1 (highest possible score = 7)
<b>Control Group</b>	2.95 (74%) Standard Dev: 0.99 n = 22	5.62 (80%) Standard Dev: 1.43 n = 21
<b>Experimental Group</b>	2.75 (69%) Standard Dev: 0.68 n = 16	5.77 (82%) Standard Dev: 1.54 n = 13

Due to the nonequivalent test questions, it is difficult to compare the two tests statistically. However, it is possible to determine the overall knowledge gain attributable to the intervention. To do so, one can divide the total possible score by the mean score in each group for the first question on each test. This calculation would provide the mean's percentage of the total possible score. Using this calculation, it can be noted that there was a greater gap between the pre-and post- test scores within the experimental group.

However, due to the differences in the number of answer choices, this question was removed during the scoring and comparisons of the two tests.

To score the remaining sections of the pre- and post-tests, the researcher gave each participant one point for every correct answer. For the last question on both tests, participants could receive partial credit. The question read “In Disseminated Lyme disease, check all of the symptoms that a patient could have.” The correct answer was all of the seven symptoms listed. Participants received one point for every symptom they checked for a possible total of seven points for that question. The mean and mode of the pre- and post-tests for each group (control and experimental) can be found in Table 4.2. In general, the pre-test scores were relatively high. The pre-test mean scores were more variable than the post-test scores, and both groups’ post-test means were higher than their pre-test means. However, the experimental group’s post-test means (standard deviation = 1.2) was far less variable than the control group’s post-test mean (standard deviation = 2.3). These results indicate that the respondents were more consistent in their responses in the experimental group. In addition, the experimental group’s post-test mean was 11.7, which was more than a one-point improvement from their pre-test mean.



Table 4.2

*Pre-test and Post-test Mean Comparisons*

	Pre-test Mean	Post-test Mean
<b>Control Group</b>	10.2 (n= 22) Standard Dev: 2.5	10.9 (n= 21) Standard Dev: 2.3
<b>Experimental Group</b>	10.6 (n=16) Standard Dev: 3.2	11.7 (n=13) Standard Dev: 1.2

As mentioned previously, the researcher had originally intended to conduct a t-test on the post-test scores to compare the means for the control and experimental groups. However, this calculation became impossible due to several factors. The first factor was the impossibility of matching the pre-and post-test scores for a given individual due to the research design. Even if the researcher could have matched the scores, the sample sizes were different. The final factor included the variance. As seen in the analysis of Question 1 on each assessment, the variance was not equal. With the aforementioned reasons, the researcher decided not to attempt a comparison of means using a t-test.

**Final Survey Results.** The final survey was used to test for the two dependent variables: self-efficacy and level of behavioral change. The design of the final survey was discussed in Chapter III. The first section regarding the variables asked participants to rate their level of confidence regarding six actions involving the Lyme disease content. Figures 4.2 – 4.6 show the level of confidence for each of the five actions. In general,

participants ranked their level of confidence as being more confident after participating in the study. The action involving recognizing Erythema Migrans (EM) rashes was not rated as highly on the confidence scale. The responses were split between unchanged and more confident.

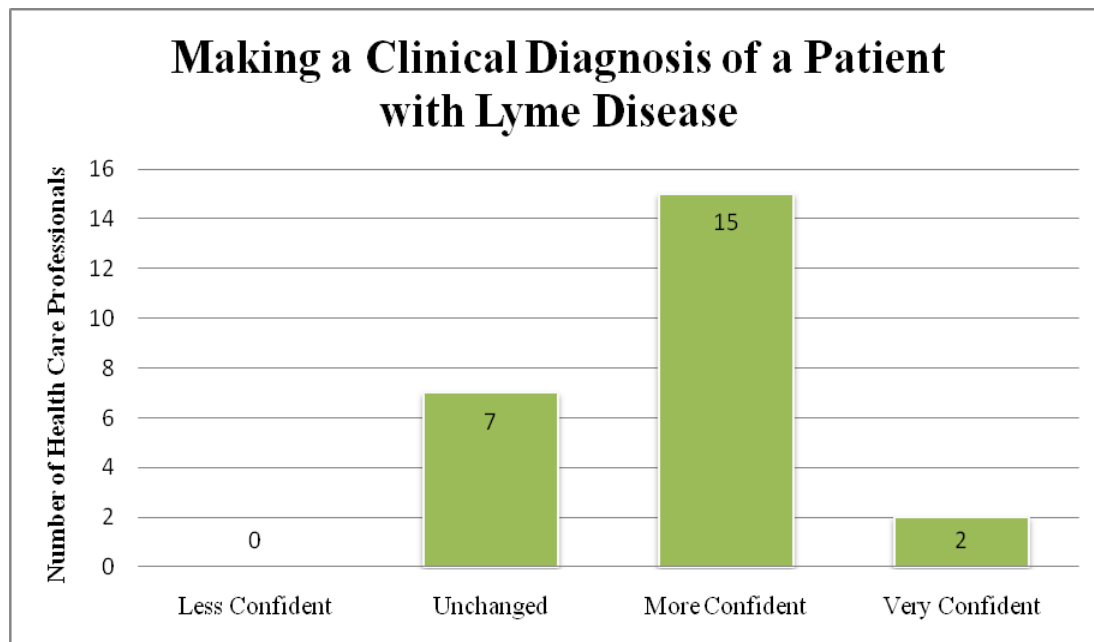


Figure 4.2. Confidence Rating for Action 1: Making a Clinical Diagnosis.

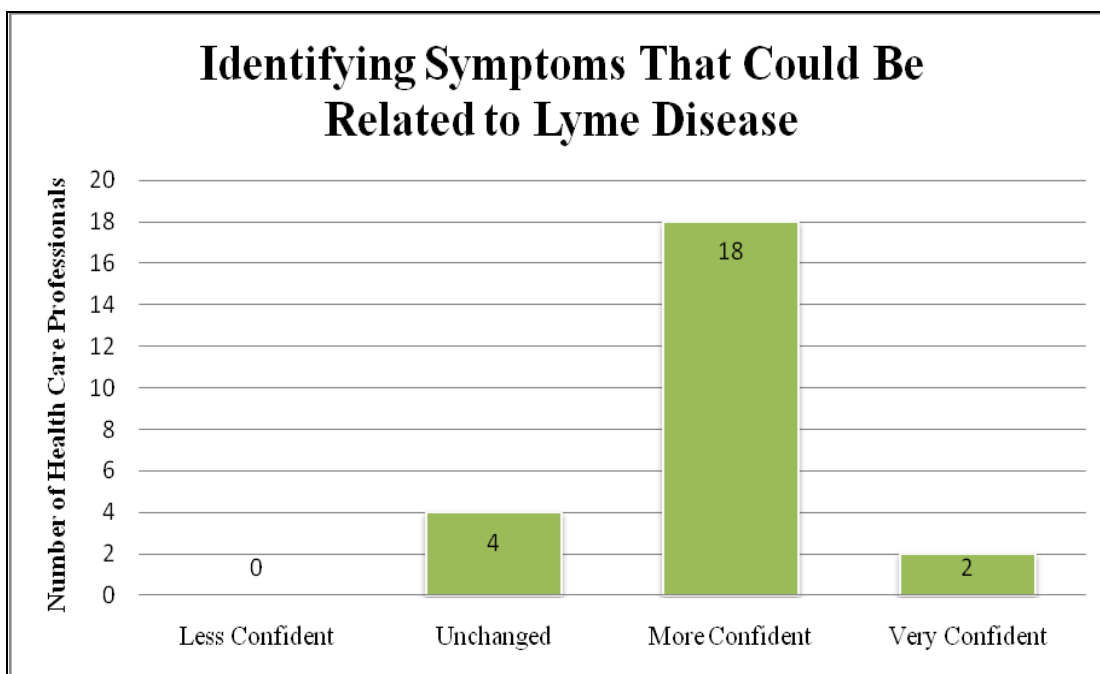


Figure 4.3. Confidence Rating for Action 2: Identifying Symptoms

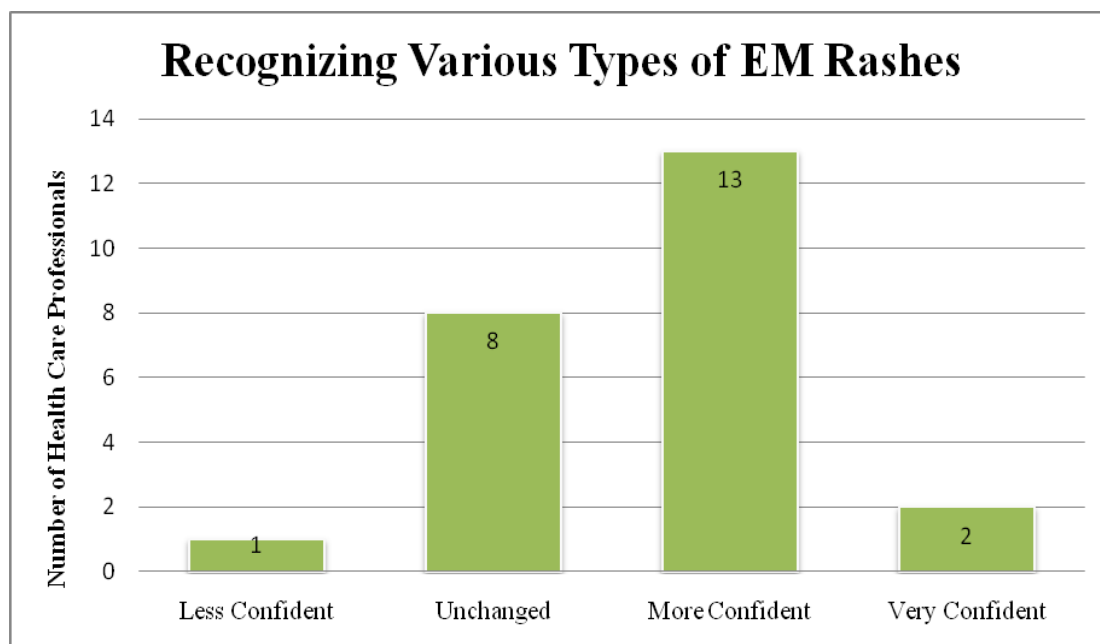
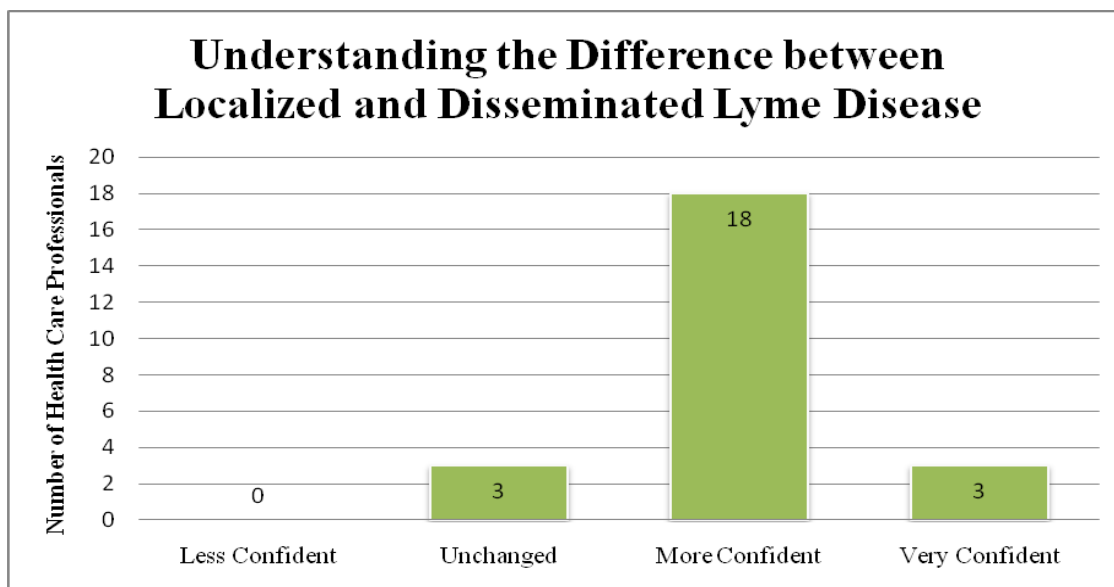
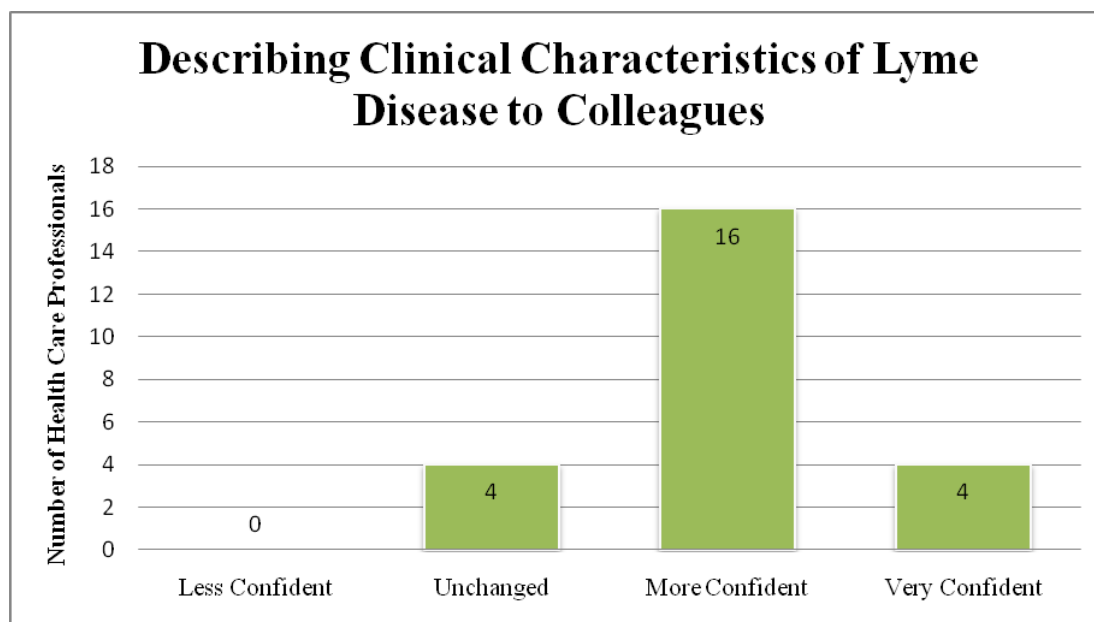


Figure 4.4. Confidence Rating for Action 3: Recognizing EM rashes. Note: EM stands for Erythema Migrans.



*Figure 4.5.* Confidence Rating for Action 4: Understanding the Difference between Localized and Disseminated Lyme disease.



*Figure 4.6.* Confidence Rating for Action 5: Describing Clinical Characteristics of Lyme disease to Colleagues

The next section of the survey included questions regarding the participants' change in behavior. The first question in the section required participants to tally how many times they had completed specific actions regarding the course itself and the course content. Table 4.3 shows the minimum and maximum times, as well as the average number of times participants completed the actions. The average value was calculated by adding the individual responses and dividing by the total number of responses. Discussing and diagnosing Lyme disease was found to be the action more participants completed.

Table 4.3

*Number of times participants completed actions related to the online course.*

Answer	Min Value	Max Value	Average Value
See a patient with an insect/tick bite.	0	4	0.4
Discuss Lyme disease with a patient.	0	15	5.0
Diagnose a patient with Lyme disease.	0	15	2.3
Refer a patient to a Lyme specialist.	0	4	0.2
Refer to the online training module.	0	1	0.0
Refer to the information you gained by completing the online course.	0	2	0.2
Refer to the case studies found in the online training module.	0	0	0.0
Refer to the online Wikispaces <sup>®</sup> discussion blog.	0	0	0.0
Refer to other web-based information regarding Lyme disease.	0	10	0.7
Collaborate with colleagues experienced in diagnosing Lyme disease.	0	5	0.7

The following question asked participants to rate their change in behavior. Figures 4.7 - 4.11 show how participants ranked their behavior concerning the five actions. Many of the participants felt that their behavior changed slightly. Participants seemed to change their behavior more concerning the symptoms of Lyme disease (Figures 4.8 and 4.9). Diagnosing patients with Lyme and referring patients to Lyme specialists seemed to be two behaviors with the least amount of change.

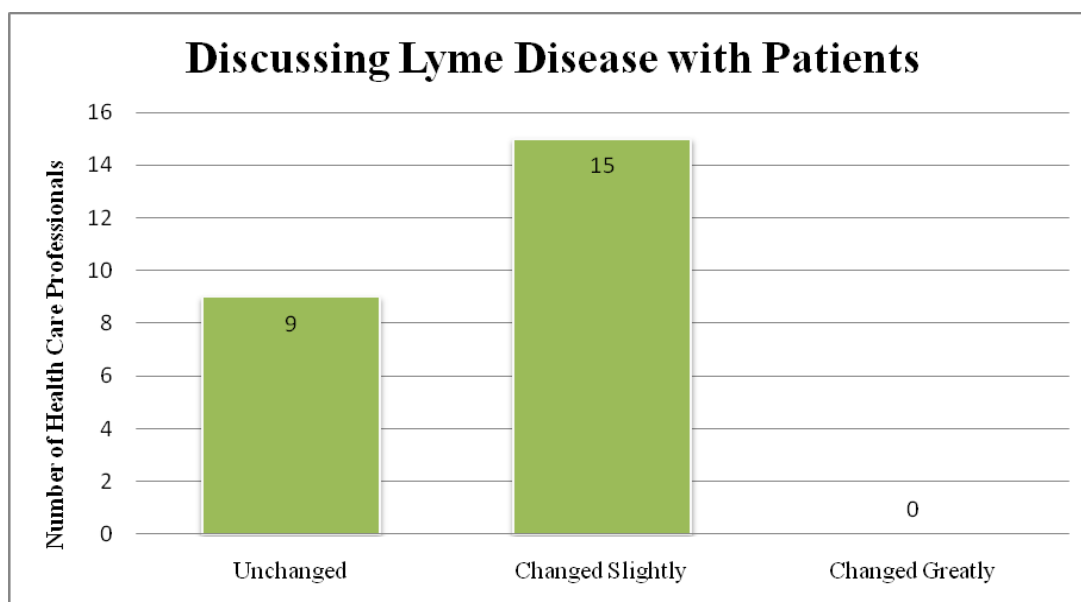


Figure 4.7. Change in behavior rankings for “discussing Lyme disease with patients.”

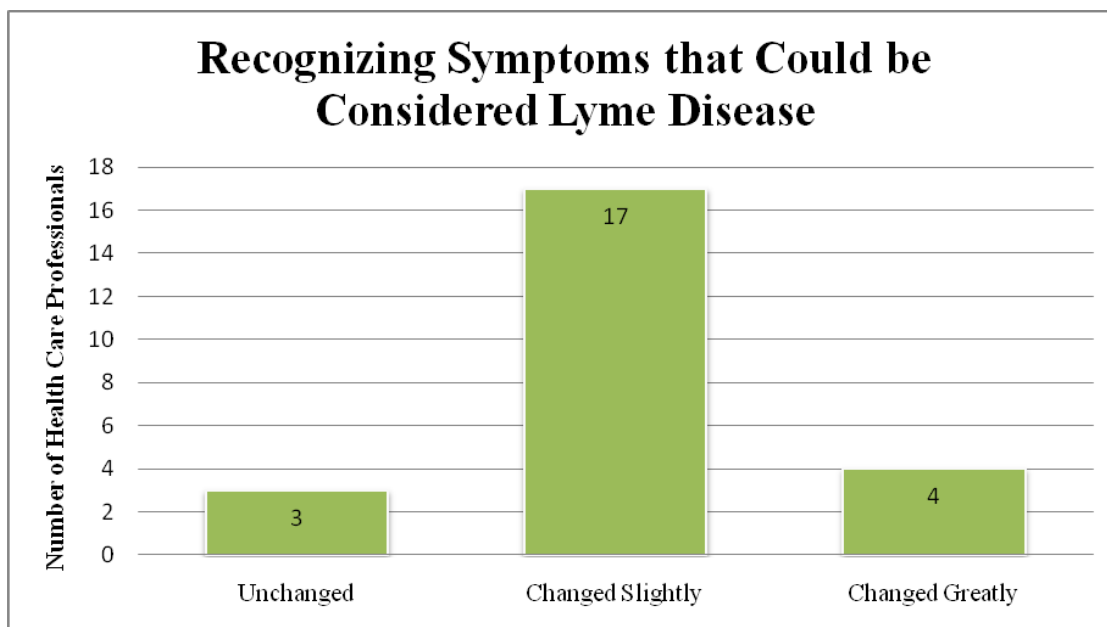


Figure 4.8. Change in behavior rankings for “Recognizing symptoms that could be considered Lyme disease.”

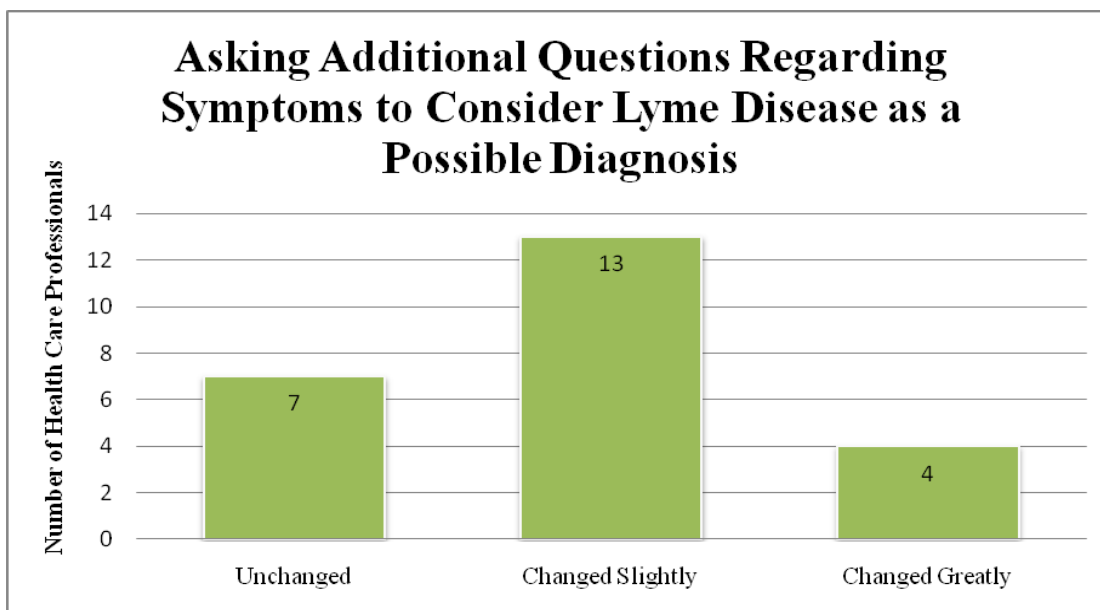


Figure 4.9. Change in behavior rankings for “asking additional questions regarding possible symptoms caused by Lyme disease.”

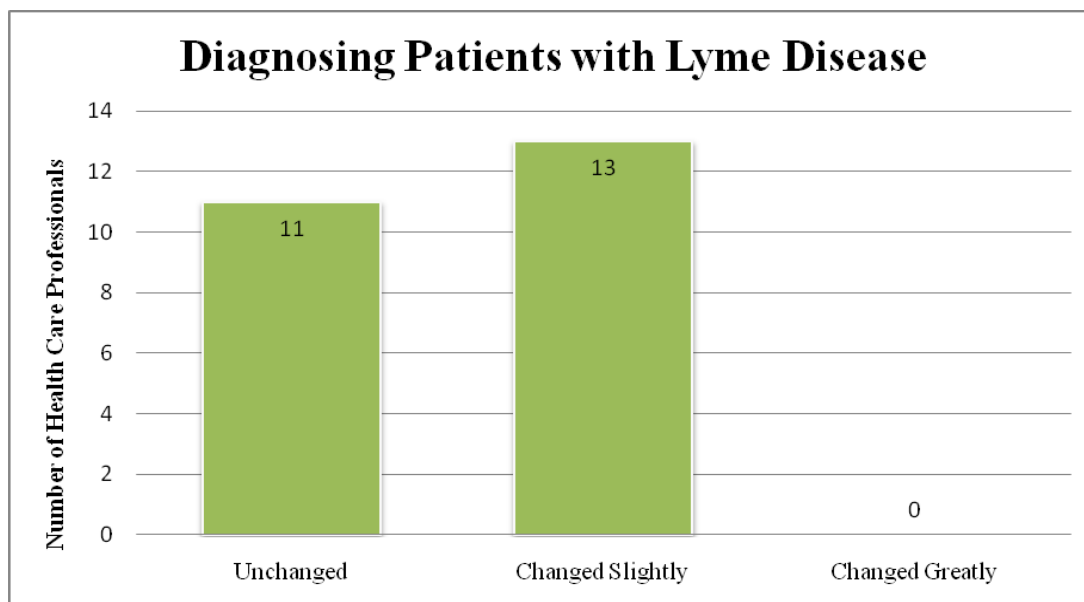


Figure 4.10. Change in behavior rankings for “diagnosing patients with Lyme disease.”

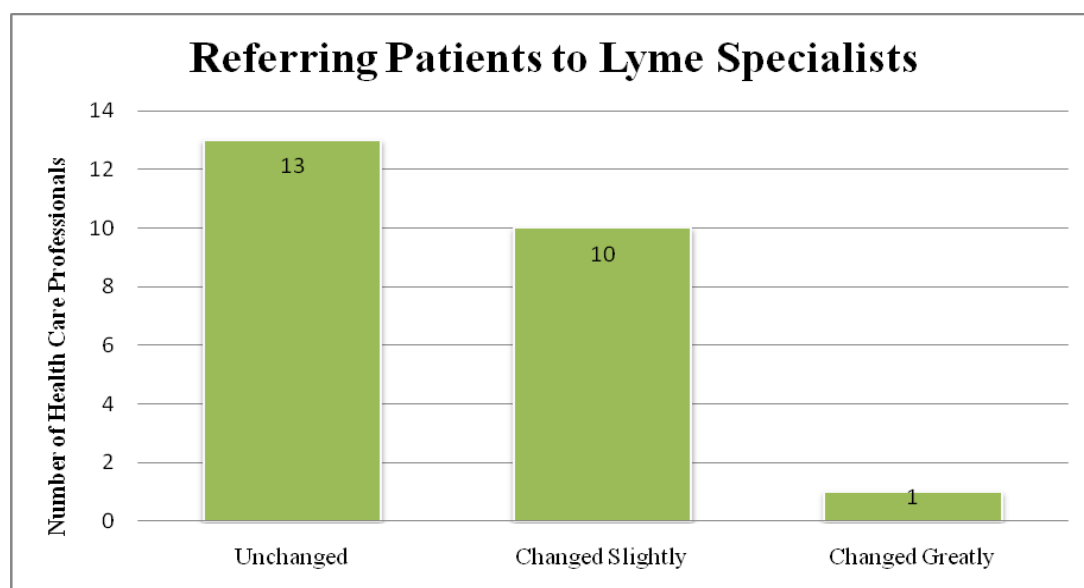


Figure 4.11. Change in behavior rankings for “referring patients to Lyme specialists.”

The experimental group participants had the opportunity to participate in an online discussion board platform via Wikispaces<sup>®</sup>. Participants watched two videos highlighting two possible Lyme disease patients and then were asked to discuss the two cases using the online discussion board. The Wikispaces<sup>®</sup> page was viewed over 50



times, and two participants posted to the discussion board. When asked in the final survey why the participant did not comment on the discussion board, participants responded that they were not interested in this form of CME, he/she did not have any further comments, or he/she had technical difficulties with the discussion board platform as it would not allow him/her to post a comment.

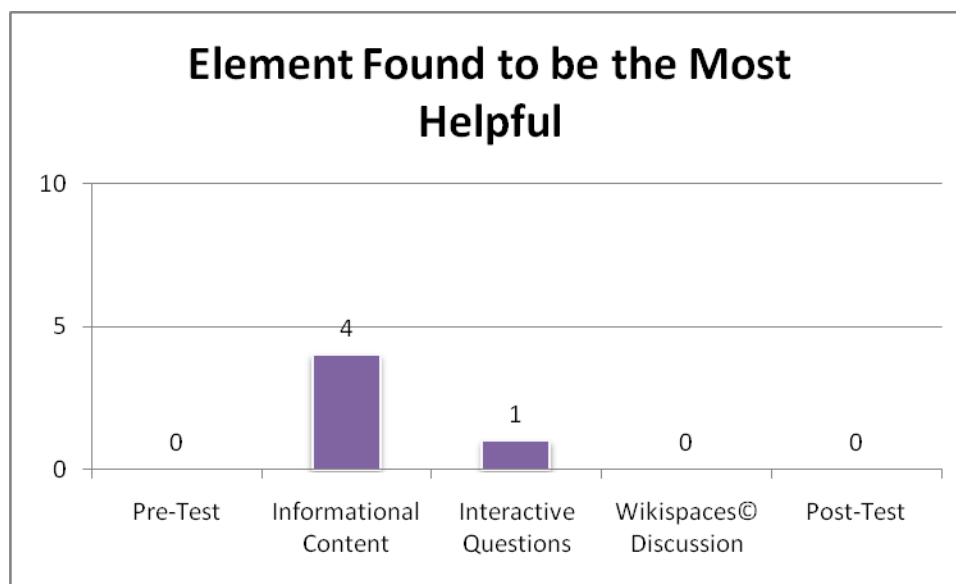
The final section of the survey had participants rank what they found to be the most and least helpful throughout the training. Due to the design of the survey (which was discussed in Chapter III), the participants who stated that they participated in the Wikispaces<sup>®</sup> activity, were given different training elements to rank than those who did not state they participated in Wikispaces<sup>®</sup>. Table 4.4 shows the two different groups of answer choices that participants were asked to rank from most to least helpful.

Table 4.4.

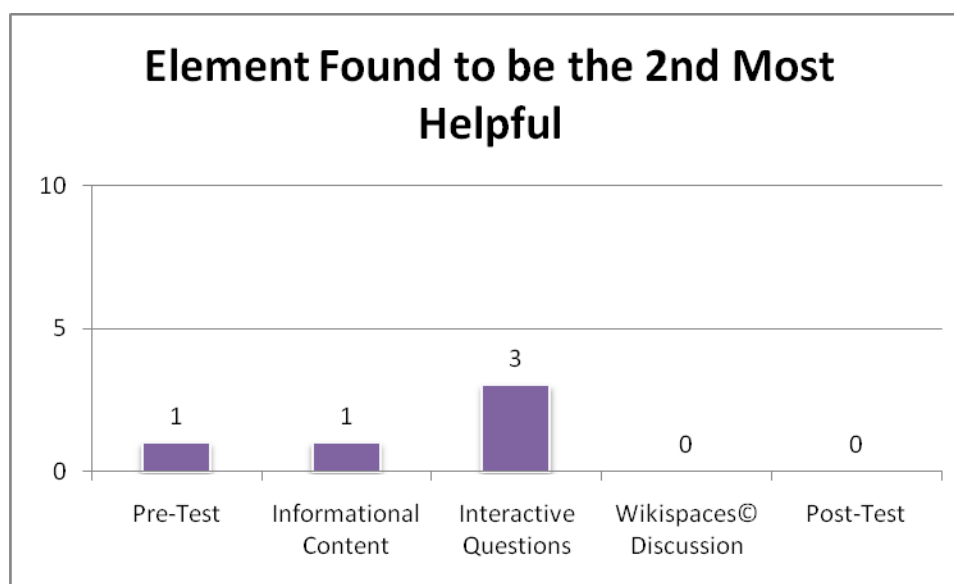
*Training elements participants were asked to rank from most to least helpful.*

Participants who DID participate in Wikispaces <sup>®</sup>	Participants who DID NOT participate in Wikispaces <sup>®</sup>
The pre-test	The pre-test
The informational content within the online training module	The informational content within the online training module
The interactive questions within the online training module	The cases found within the online training module
The online Wikispaces <sup>®</sup> discussion	The post-test
The post-test	

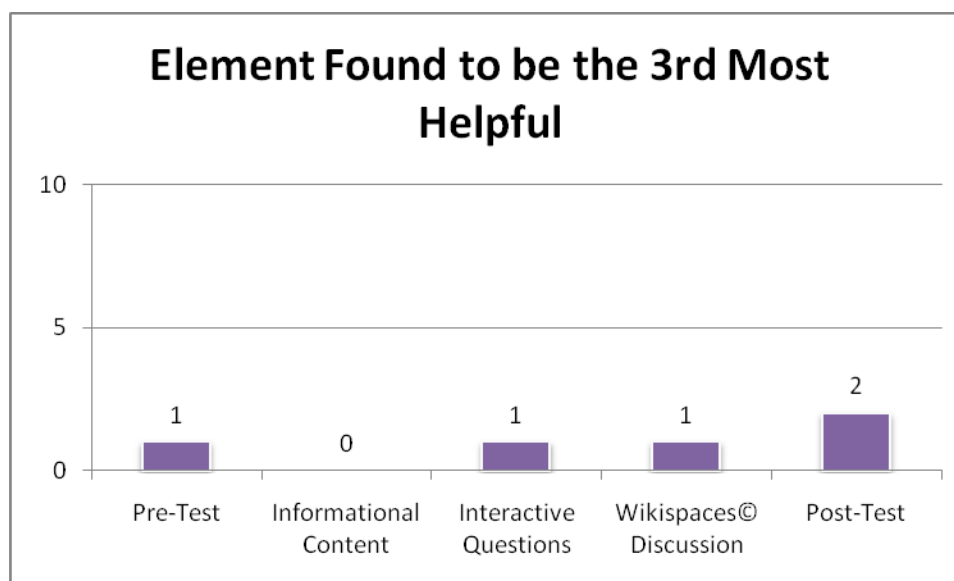
Figures 4.12 through 4.16 illustrate the elements' rankings according to the participants who stated they DID take part in the Wikispaces<sup>®</sup>. Participants ranked the informational content as the most helpful and the interactive questions as the second most helpful. However, the Wikispaces<sup>®</sup> discussion board element was ranked the least helpful by participants.



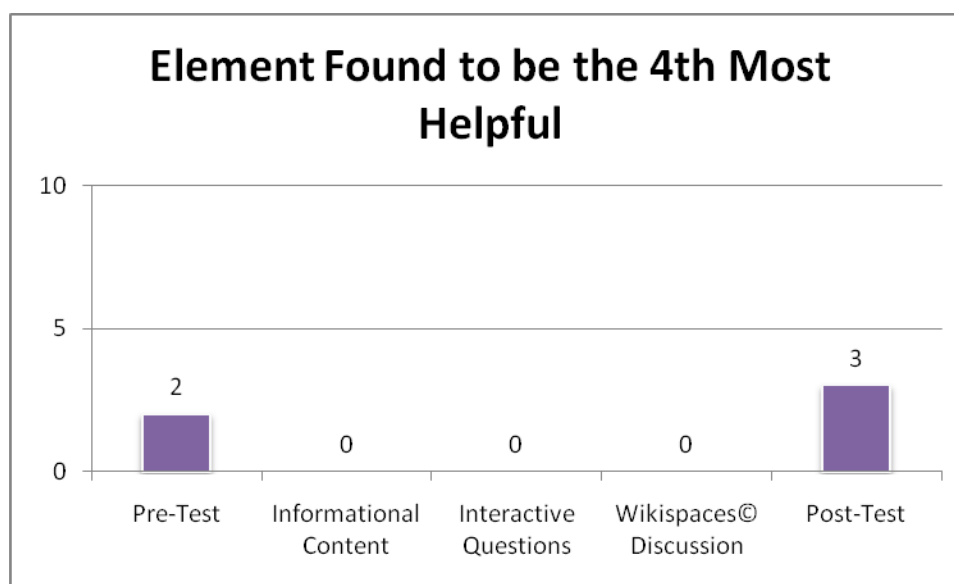
*Figure 4.12.* The instructional element found to be the most helpful from the group who did participate in the Wikispaces<sup>®</sup>.



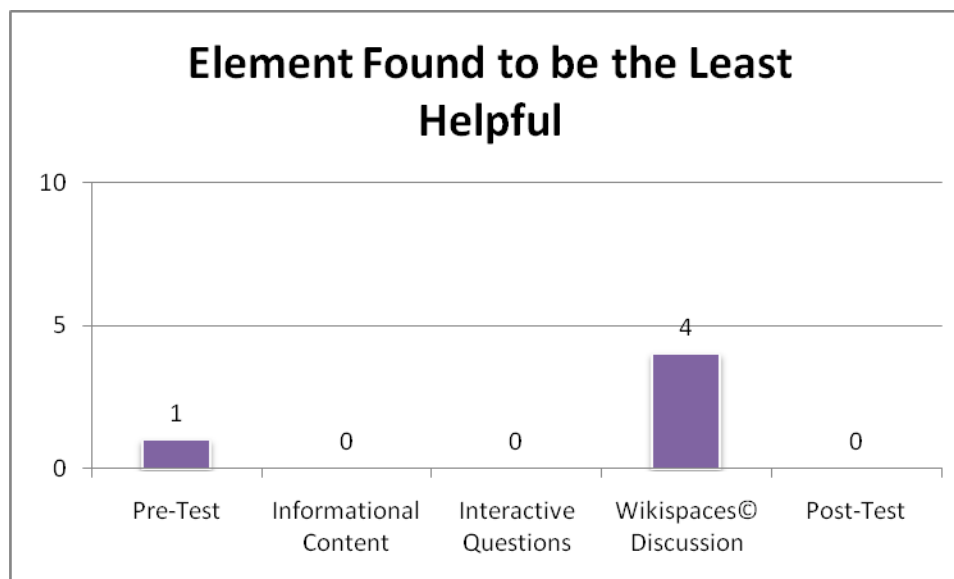
*Figure 4.13.* The instructional element found to be the 2<sup>nd</sup> most helpful from the group who did participate in the Wikispaces©.



*Figure 4.14.* The instructional element found to be the 3<sup>rd</sup> most helpful from the group who did participate in the Wikispaces©.

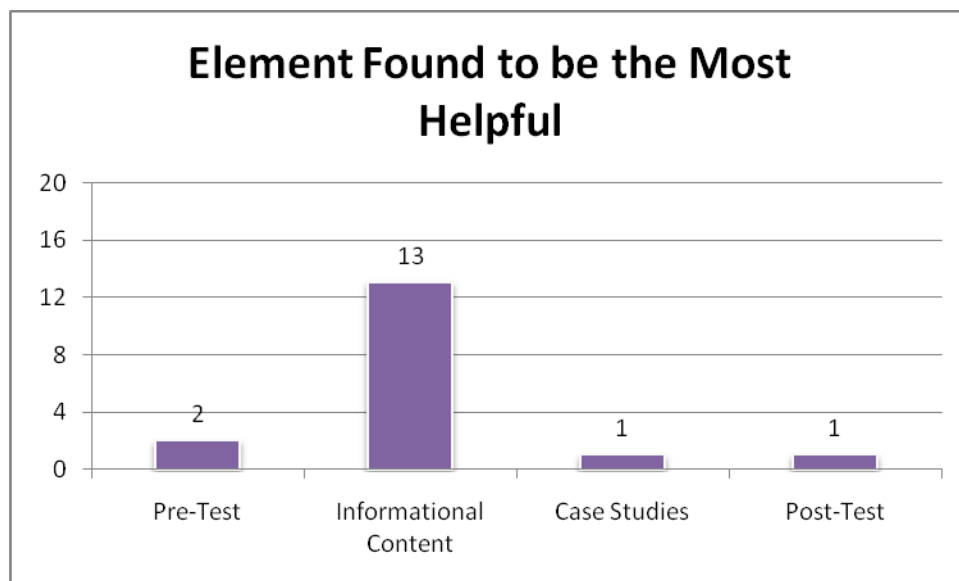


*Figure 4.15.* The instructional element found to be the 4th most helpful from the group who did participate in the Wikispaces©.

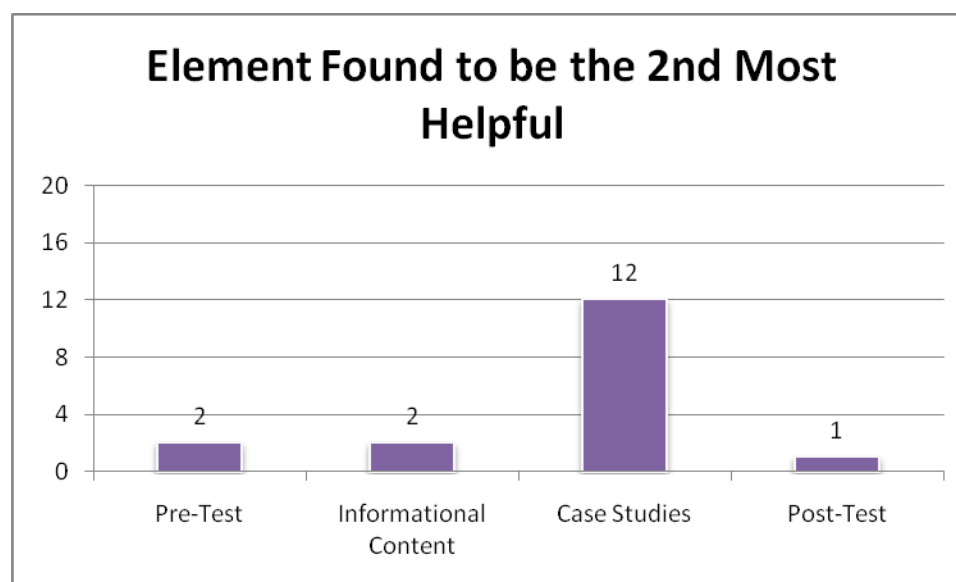


*Figure 4.16.* The instructional element found to be the least helpful from the group who did participate in the Wikispaces©.

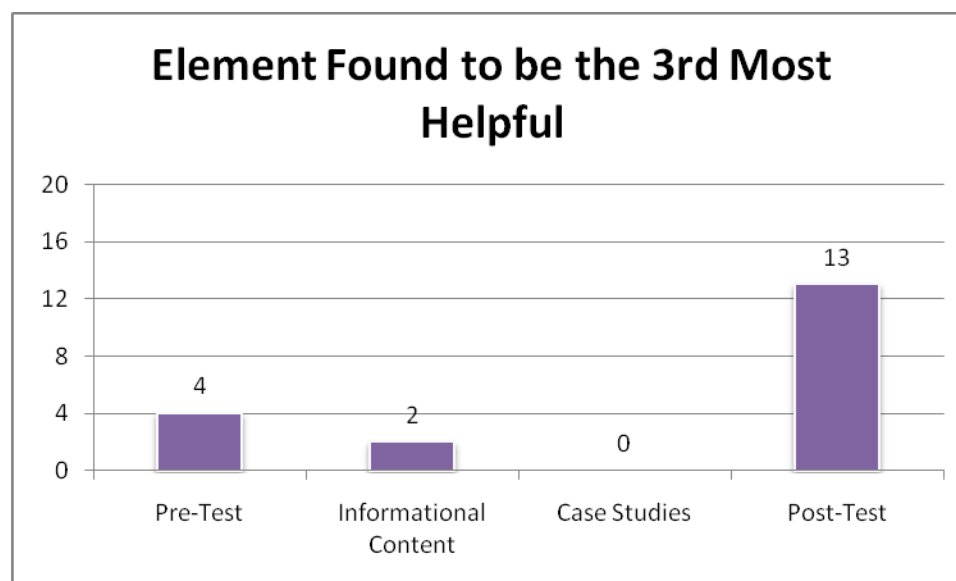
Figures 4.17 through 4.20 show how the participants who DID NOT take part in the Wikispaces<sup>®</sup> discussion board ranked the instructional elements. As with the other group of participants, the majority of the participants ranked the informational content as the most helpful. The case studies were the second most helpful instructional element by the group who did not participate in the Wikispaces<sup>®</sup> discussion. When asked to rank the least helpful element, the group who did not participate in the Wikispaces<sup>®</sup> discussion chose the pre-test.



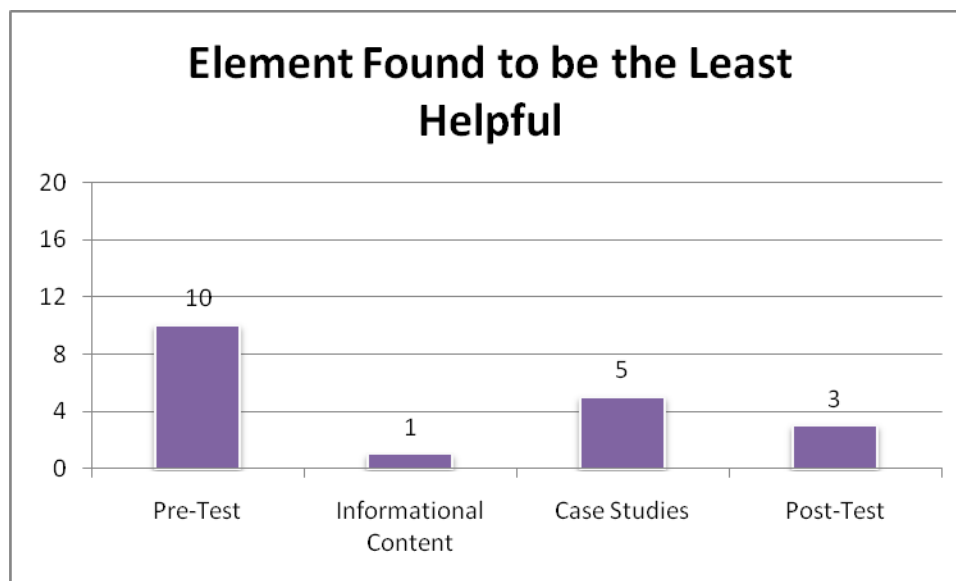
*Figure 4.17.* The instructional element found to be the most helpful from the group who DID NOT participate in the Wikispaces<sup>®</sup>.



*Figure 4.18.* The instructional element found to be the 2<sup>nd</sup> most helpful from the group who DID NOT participate in the Wikispaces<sup>®</sup>.



*Figure 4.19.* The instructional element found to be the 3<sup>rd</sup> most helpful from the group who DID NOT participate in the Wikispaces<sup>®</sup>.



*Figure 4.20.* The instructional element found to be the least helpful from the group who DID NOT participate in the Wikispaces<sup>®</sup>.

### **Qualitative Data**

Qualitative data was collected to support the researcher's quantitative results. Four interviews were conducted using the questions from the final survey. Table 4.5 provides the demographics for each of the interview participants. The group included two medical doctors and two students (one medical and one nursing). One interviewee was from the control group with the remaining three interviewees from the experimental group. The researcher interviewed two males and two females.

Table 4.5

*Demographics of the Interview Participants.*

Name	Medical Title	Experimental/Control Group
<b>Interviewee A</b>	Medical Doctor Board Certified in Pediatrics	Control
<b>Interviewee B</b>	Medical Doctor Board Certified in Family Practice	Experimental
<b>Interviewee C</b>	Medical Student Interested in Emergency Medicine	Experimental
<b>Interviewee D</b>	Nursing Student Interested in Pediatrics	Experimental

Each interview lasted between seven and thirty minutes. To protect the identity of each participant the researcher stripped all identifying information before presenting the results. To maintain consistency in the interview protocol, the researcher followed the steps discussed in Chapter III (p. 101) throughout the qualitative collection process.

**Confidence Level.** In the final survey, all participants were asked to rate their level of confidence using a Likert-scale. In order to obtain a deeper level of understanding, the researcher asked interviewees to express their level of confidence within the same behaviors listed in the final survey. These behaviors were:

- Making a clinical diagnosis of a patient with Lyme disease
- Identifying symptoms that could be related to Lyme disease
- Recognizing various types of EM rashes
- Understanding the difference between localized and disseminated Lyme disease



- Describing clinical characteristics of Lyme disease to colleagues.

Even though Interviewee A did not engage in the interactive elements, he rated his confidence levels with the listed actions as “very comfortable” (personal communication, February 17, 2011). He felt that his knowledge was enhanced especially in the content areas concerning Erythema Migrans rashes and understanding the differences between the stages of Lyme disease. After questioning his confidence in the specific actions, he explained that Lyme disease is not something he and his staff deal with everyday. He believed “the more you do it the more comfortable it will become” (personal communication, February 17, 2011).

Interviewee B also rated her confidence levels as confident (stages), pretty confident (clinical diagnosis), and very confident (clinical characteristics, EM rashes, and symptoms). She stated that she has had “many discussions about it [Lyme disease]” before and after the online CME course.

Interviewee C reported that he felt “definitely more confident” after the course in the topics pertaining to the symptoms, clinical diagnosis, and stages of the disease. When asked if he felt confident speaking to other colleagues about the disease he responded with “the course gave you a better understanding and vocabulary to help convince or speak to other partners about making that diagnosis” (personal communication, February 23, 2011).

Interviewee D felt she was confident in the majority of the actions. She was previously a Lyme disease patient, which meant she was previously familiar with the disease. When rating her confidence with identifying EM rashes, she rated her

confidence level lower due to the variability of the types of rashes; some she felt more confident in recognizing than others.

**Behavior Changes.** Along with questioning interviewees on the level of confidence, the researcher also asked them to rank their change in the following behaviors:

- Discussing Lyme disease with patients
- Recognizing symptoms that could be considered Lyme disease
- Asking additional questions regarding symptoms to consider Lyme disease as a possible diagnosis
- Diagnosing patients with Lyme disease
- Referring patients to Lyme specialists.

Even though the confidence level of the interviewees all increased, the behaviors did not all change.

The behavior of interviewee A did change. “Lyme disease passes through his mind more often, especially with the joint systems because they are not “classic” symptoms. He has also ordered more diagnostic tests since taking the online course” (personal communication, February 17, 2011). After taking the course, Interviewee A began to ask “more questions regarding a patient’s social life” in order to consider Lyme disease as a possible diagnosis (personal communication, February 17, 2011). Even though Interviewee A has changed his behavior regarding identifying the symptoms and even with diagnostic tests, he has yet to have any positive test results, diagnose a patient with Lyme, or send anyone to a Lyme specialist.

Interviewee C also felt that his behavior changed since participating in the course. “By taking the course and finding more about the disease it will help you speak to patients, recognize the symptoms, and help the patient pursue the right type of treatment” (personal communication, February 23, 2011). Essentially, he described his behavior as improved; he “learned some new skills and things to look for and the right questions to ask to lead to that diagnosis” (personal communication, February 23, 2011).

When reporting about her behavior, Interviewee B did not feel her behavior changed as much as other participants. Her behavior towards recognizing symptoms was the only behavior she rated as “changed slightly” (personal communication, February 17, 2011). There were a few symptoms that Interviewee B learned more about during the course. The other behaviors she expressed no change. Interviewee B previously performed the listed behaviors and subsequently not changed her behavior after the course. Interviewee B’s explanation could also account for the lack in behavior change of other participants who had previous knowledge and experience with Lyme disease (who were not interviewed).

Interviewee D also did not have a significant change in behavior due to her current patient status. She has had previous patient interaction, but currently she is not working with them. This situation could have also been the case with other participants who did not complete an interview. The demographics of the survey did report a portion of the sample were students.

**Instructional Elements.** During the interview, the researcher questioned participants about the discussion board platform (Wikispaces<sup>®</sup>), and which instructional element they found to be the most and least helpful. Interviewee C participated and

posted to the Wikispaces<sup>®</sup> discussion board. Unfortunately, after posting he misplaced the web address and could not return to the webpage to see what others had posted and interact further. Interviewees B and D also had the opportunity to participate in the Wikispaces<sup>®</sup> discussion board. However, due to technical difficulties with the Internet connection, Interviewee B explained that she did not participate in the discussion. Interviewee D decided not to participate due to the time commitment she felt it would have required. The reasoning behind Interviewees B and D not participating in the discussion could have also been why other participants did not participate.

Interviewee A felt that the course was an “excellent refresher.” He felt the course content was the most helpful, “especially the breadth of the different stages and its overall comprehensive nature” (personal communication, February 17, 2011).

Interviewees B and D both agreed that the stages and symptom sections were the most helpful, as these were the sections from which they gained the most knowledge.

Interviewee C felt the interactive questions were the most helpful as they provided a checkpoint to see “if you are following along and catching the main points” (personal communication, February 23, 2011). Interviewee D also agreed the interactive questions were helpful.

Interviewees A and D felt the pre-test was the least helpful. Both A and D agreed that they wanted to begin the content portion right away. Interviewee B felt the “post-test needed to be more comprehensive” (personal communication, February 17, 2011). She was also dissatisfied with the lack of feedback regarding the answers to the pre- and post-tests. Interviewee C did not report on what he found to be the least helpful.

In the future, Interviewee A would like to see more videos with realistic situations as well as situations with the instructor guiding the learning. Interviewee B wanted the content to be organized into one, large section. She found the sections in which she had to move between slides difficult to follow and felt that it broke her concentration. Due to the opinion that doctor's like facts and figures, Interviewee C would like to see more CME courses include relevant journal articles.

Chapter IV discussed the methods used to analyze both the qualitative and quantitative data. The final chapter (Chapter V) will further discuss these results and will conclude the present study.

## **Chapter V. Discussion, Conclusions, and Implications**

### **Discussion**

The purpose of this study was to gain a greater understanding of how interactive elements affect health care professionals' self-efficacy and behavioral change in an online Continuing Medical Education (CME) course. The researcher hypothesized that participants who completed the online CME course that included interactive elements would have a deeper understanding of the presented content, leading to higher self-efficacy and result in behavior change within their practice. This hypothesis was partially supported with the results of the present study. In general, it was found that the majority of all participants in both experimental and control groups increased their knowledge of the content (Lyme disease), improved their self-efficacy, and did change their behavior to an extent. However, the media, or interactive elements, was not shown to be the reason for the changes.

When comparing the mean scores of the pre-test and post-test, the experimental group with the interactive elements had a higher original score and score increase between the two tests. In addition, there was a larger knowledge gain in the experimental group compared to the control group. These results support similar findings of the studies conducted by Mazzoleni et al. (2009), Wutoh et al. (2004), and Cook et al. (2008). Even though these prior studies did not contain the exact instructional elements of the present study, they have all shown that online CME interventions do contribute to a gain in knowledge of health care professionals. However, it should be noted that the present study contained a small sample with unequal group sizes and nonhomogeneous variance. These facts undoubtedly affected the results of the study.

As reported by the participants, the majority experienced an increase in the level of self-efficacy. This increase was especially true in regard to identifying the symptoms and understanding the differences in the stages of Lyme disease. The quantitative data from the final survey was supported by the qualitative data. The interviewees all commented on the symptom section within the course, and how this section seemed to provide the highest knowledge gain. When asked about the participants' confidence level in regard to the stages of Lyme disease, Interviewee A understood how the body systems fit into the stages after the course. Interviewee C also felt more confident in that he previously did not know there were any differences/stages in Lyme disease.

The self-efficacy level experienced when identifying EM rashes was not as explicit. The confidence in this category was split between unchanged and more confident. When interviewed, Interviewee D commented that she felt the least confident in this category due to the variability of the types of rashes. However, Interviewee A enjoyed the EM rash section due to the realistic pictures, and consequently, he rated his confidence level as higher.

When analyzing the results of the assessed behavioral change, it can be noted that the overall behavior of the majority of participants did change after the course. However, the level of change was more variable than the level of confidence. Table 4.3 (p. 111) referred to the number of times participants completed actions regarding the content or course materials. The two actions with the highest average and max number was discussing Lyme disease with a patient and diagnosing a patient with Lyme disease. When comparing these actions to the self-assessed behavioral change scales, diagnosing patients with Lyme disease was more split between unchanged and slightly changed.

These results show that some participants did change their behavior. The ones that did not change their behavior may have previously performed these behaviors on a regular basis. This prediction was supported by the qualitative data. Interviewee B stated that her behavior did not change because she was not only knowledgeable about Lyme disease before the course, but had also been diagnosing and treating patients with Lyme disease. For this reason, her behavior did not change. This reasoning could account for the large number of unchanged responses in the categories of diagnosing a patient and discussing Lyme disease with a patient. In retrospect, the researcher realized that she should have assessed participants' familiarity with Lyme disease prior to course administration.

Even though the study did show that participants experienced an increase in knowledge gain, self-efficacy, and change in behavior, it was not shown to be due to the interactive elements within the experimental group's course. The change in the dependent variables was found to be true for the majority of the participants. The instructional elements were not found to be the reasoning behind the change. Due to the design of the final survey, it was not known which participants who ranked their self-efficacy or behavior as higher or changed were in the control or experimental groups. This design flaw caused the researcher to evaluate the level of self-efficacy and behavioral change of the participants as one single group.

One of the interactive elements within the experimental group's course was the online discussion board, Wikispaces<sup>®</sup>. In the discussion board platform, participants were asked to watch two video case studies and respond to the discussion questions using the discussion board forum. The number of participants who participated in the online



discussion board was extremely low, with only two participants posting on the discussion board. The quantitative data supported this lack of interest. In the final survey, participants stated they either were not interested in that form of CME or they did not have any additional comments to post after reading the two postings by other participants. This lack of interest was also found within the qualitative data. Interviewee B and D identified technical difficulties with the Internet and/or Wikispaces<sup>®</sup> as contributing to their lack of participation. Other research has found that technical difficulties and lack of interest are major barriers for the use of online discussion boards within online CME courses (Gagnon et al., 2007; Guan et al., 2008; Sargeant et al., 2000).

On the other hand, Interviewee C did post on the discussion board, but did not return to see what others had posted. The lack of interactions between participants using the discussion board was supported by Sargeant et al.'s study (2000). In the study conducted by Sargeant et al. (2000), overall participation within the discussion board was relatively high. However, the interaction between the individual participants was sporadic. In a study conducted by Wiecha and Barrie (2002), participation and interest levels with an online discussion board were high. Unfortunately, this interactive element was not popular nor did it seem to be a successful feature within the experimental group's course. These conflicting results (between Wiecha & Barrie's and the present study) show that future research regarding discussion boards is needed.

The content and layout of the two courses were ranked as the most helpful instructional element in the final survey; the interviewees also agreed. Interviewee B said that even though she was previously familiar with Lyme disease, she continued to increase her knowledge and confidence due to the extensive content detail. Interviewee A

also agreed that the course was an “excellent refresher” (personal communication, February 17, 2011). The sections that were found to be the most sound in regard to content was the symptom section and the section detailing the various stages of Lyme disease. This information coincided with the greatest self-efficacy and behavioral change.

With the content being ranked as the most useful, this study has shown that the media within an online course is not the sole cause of knowledge gain, self-efficacy, and behavioral change. Instead, the knowledge gained in an online course is dependent upon instructional design practices. The media used are simply the vehicles used to deliver instruction. This concept is supported by the research conducted by Clark (1983). In his analysis, he states that media “do not influence student achievement” (Clark, 1983, p. 445). The interactive elements did not cause the overall increase in knowledge, self-efficacy, and change in behavior. “It is what the teacher does,” or in this case, the instructional designer, “that influences the learning” (Clark, 1983, p. 456). Designers should use “well-designed curricula regardless of the method of delivery” (Chumley-Jones, Dobbie, & Alford, 2002, S89). The designer presented and organized the new content using sound instructional design principles (Gagne’s nine events of learning, Universal Design for Learning, Social Cognitive theory, Andragogy, etc.), which have been found to assist with learning, self-efficacy, and behavioral change. Further research needs to be conducted in order to examine whether individual instructional elements are the primary cause of these increases.

### **Strengths and Limitations of Study**

Even though the results of the study did not fully support the hypothesis presented by the researcher, there were strengths within the present study. The researcher made a concerted effort to use sound instructional design practices in the development of the online course materials. Other CME and instructional designers may be able to utilize this study's framework to organize and structure future research studies. The instruments would need to be improved; however, the experimental design could be used.

Potential limitations were present in this study. The participants sampled were selected from a variety of health professions. This variety could have caused the results to be less consistent due to the variances in experiences and prior knowledge. If the same sample is used in the future, the data should be collected from the same genre of health care professionals or organized by the type of health care professional (nurse, physician, etc.) when analyzing the data.

The participants' interest or lack of interest could have affected the data of the pre- and post-tests as well. If participants completed the pre-test and then became disinterested, there was a high risk that he/she did not complete the remaining components of the training. The researcher made every attempt to prevent this from happening. However, due to confidentiality, the researcher did not know who did or did not complete all of the training components. This lack of information could have caused the data to be skewed. On the contrary, if participants were highly interested in the material, the pre- and post-test scores could be especially high which could have also skewed the data.

Another major limitation revolved around the prior knowledge and experiences of each participant and their reported change in behavior. If the participant previously performed the listed behaviors, he/she may have rated their behavior as unchanged. Even though their behavior didn't change, they still could be using the new information with their behaviors after participating in the course.

The patients each participant examined during the three-week period between the training and the final survey could be considered one of the larger limitations of this study. The researcher did not evaluate the number of patients seen, nor did the researcher evaluate the various cases each participant handles, during the three-week period. The types and number of patients each participant interacted with could determine how frequently or infrequently the participant utilized the new information and had an opportunity to change his/her behavior. In order to overcome this confound, the researcher used a self-assessment of self-efficacy of the participant along with the test for behavioral change. By showing an increase in self-efficacy, the participant would be more apt to utilize the new information when the opportunity arises.

As previously mentioned, there were limitations regarding the data analysis. First, researcher was unable to conduct the planned t-test because the data were not attributable to individual participants, the samples were of unequal size, the variance was nonhomogeneous, and the sample size was too small. The second limitation within my data analysis was in regard to my survey design. The contingency question that was designed to separate the control group and experimental group did not properly divide the groups. This detail also could have caused the data regarding the instructional element

rankings to be skewed. In the future, a stronger designed survey should be used in order to differentiate between the two groups.

One final limitation was the bias that could have come from having participants conduct a self-assessment of their amount of knowledge transfer. Griscti and Jacono (2006) discussed this limitation in their literature review of Continuing Education programs. Participants could have had varying opinions of what accounts for the degree in which he/she has utilized the new knowledge. The authors discussed other methods including direct observations, evaluation of patient outcomes, and “monitoring client records” (p. 454). However, it was beyond the scope of the current study to have access to professional medical records or patient information in order to do a more thorough analysis.

### **Recommendations for Future Research**

The present study evaluated how health care professionals’ behaviors concerning Lyme disease diagnosis changed over the course of three weeks. Future studies should extend this research by comparing the previous behaviors to behaviors at three weeks, six weeks, etc. after the online course. This method would help to compare the change in behavior regardless of previous knowledge or experience. For example, in the present study, if a health care professional rated their behavior as unchanged, the researcher could have had a better understanding of the unchanged behavior if he/she knew the behaviors the participant was doing before the course. By analyzing the behaviors of participants before the intervention and further than three weeks after the intervention, the researcher could obtain a better understanding of the amount of knowledge transfer from the course to their practice. Future research should also collect data in regard to the

behavioral change using a method other than self-reporting. This action would strengthen the results in that the researcher would have more solid evidence of knowledge transfer further than the participants' opinions.

Another challenge faced in the present study was the sample size and the dropout rate that occurred as the study progressed. Future research should account for this limited participation by offering a stronger motivation to participate throughout the study. One suggestion would be to offer actual CME credit for participating. Due to the fact the present study was a pilot study, there was limited motivation for participants. If future research extended the time frame of the study (to allow participants more time to complete the course) and offered CME credit, then more health care professionals may be willing to participate.

Logistically, future research should improve upon the present study by increasing the overall time frame of the study. One complaint throughout the present study was the participants wanted more time to complete the course. This request was out of the scope of the present study. However, in the future, researchers should take the factor of time into consideration. One suggestion would be to extend the study over one year. Participants could complete the study on their own time schedule. Once they had completed a step within the course, then their evaluation time line would be on an individual basis. This modification would allow more health care professionals to participate, which would increase the sample size (a limitation to the present study).

A major limitation of the present study was the method of data collection and analysis. The assessment instruments should be redesigned for future research. The pre- and post-test should be created so that the questions are more similar, and the tests are

equivalent. The first question on each test would need to be re-designed, so that it could be included in the overall analysis of pre- and post-tests. Re-designing and improving the consistency between the pre- and post-tests may afford additional, more robust statistical analyses.

The survey design also would need to be stronger in the future. The contingency question that separated the experimental group from the control group should be re-written. This correction would allow for more information to be collected regarding the online discussion board and interactive questions. If the participants who had the option of completing the discussion board did not participate, then the researcher did not know why unless they answered the contingency question in a specific way.

Continuing Medical Education interventions continue to increase in quantity. However, the quality of these courses should be evaluated and improved upon in order to change the behaviors of health care professionals. Interactivity was not found to be the sole reason health care professionals increased their knowledge, reported a higher self-efficacy, and changed their behaviors in the present study. However, the instructional design of online learning is important as shown in the present study. Researchers should continue to investigate the instructional elements of online courses to see which elements are found to be the most beneficial for learners' knowledge and self-efficacy, which will in turn change the behavior of the learner.

## **Appendices**

Appendix A contains the cover letter and IRB-approved consent form emailed to the participants. Appendix B contains the matrices used in the researcher's evaluation of three current CME courses. Appendix C contains the Pre- and Post-Test instruments. Appendix D contains the final survey instrument. Appendix E contains the IRB-approved consent form used for the participants in the interview process. Appendix F contains the full interview notes for each participant.



## **Appendix A: Study Consent Form**

### **Cover Letter:**

Dear Health Care Professional,

You are being asked to participate in a graduate research study involving Lyme disease and online CME education. I am a graduate student at James Madison University pursuing a degree in Adult Human Resource Development with a concentration in Instructional Design. For my graduate thesis work, I will be investigating whether interactive elements included in online CME (Continuing Medical Education) promote a deeper understanding within health care professionals and cause them to transfer the new knowledge in order to change their behaviors within their medical practice.

I would very much appreciate your participation in my study. This research study will ask that you complete an online training course regarding topics on Lyme disease and then complete an online survey three weeks after your completion of the online course. This research study will act as a pilot study for a future, accredited CME course. At the end of the course requirements you will be given an opportunity to request future information regarding the accredited CME course and to enter a raffle drawing for a fabulous prize including the “Under Our Skin” DVD or the “Insights Into Lyme Disease Treatment: 13 Lyme-Literate Health Care Practitioners Share Their Healing Strategies.”

To participate in the study, click on the link below to access the online CME course. By clicking on the link, you are agreeing to the consent form below.

Link Added Here

Once again, thank you for your participation!

Sincerely,

Monica Blackwell

## **Online Consent Form:**

### **Identification of Investigators & Purpose of Study**

You are being asked to participate in a research study conducted by Monica Blackwell from James Madison University. The purpose of this study is to assess whether the interactive elements included in the CME course promoted retention and transfer in a way that would be portrayed in the behavior of the participants. The researcher will assess a change in behavior and the participants' self-efficacy using survey questions that are based on the objectives in the training. They include but are not limited to diagnosing Lyme disease and identifying the symptoms of Lyme disease. The current research study will answer the following research question: How can one design online instruction that will foster a change in health care professionals' behavior from the course and into medical practice and increase their self-efficacy with the presented content? This study will contribute to the researcher's completion of her master's thesis. It will also act as a pilot study for future, accredited CME course.

### **Research Procedures**

This study consists of 1) a pre-test, 2) an online CME course, 3) a post-test, and 4) a follow up survey 3 weeks after taking the course. The pre-test and post-test will ask you questions regarding your knowledge of Lyme disease. The follow up survey will ask you to provide answers to a series of questions related to your behavior regarding Lyme disease after completing the online course. Once you have completed the final survey you will be directed to a form in which you can sign up to receive information regarding the future accredited CME course as well as a raffle drawing, if you wish to do so.

### **Time Required**

Participation in this study will require that you participate in the online tutorial and the online survey. The online course will require less than 90 minutes of your time. The online survey will require less than 10 minutes of your time. However, there will be a time lapse of three weeks in between the tutorial and the online survey.

### **Risks**

The researcher does not perceive more than minimal risks from your involvement in this study. All answers to the online survey will remain confidential including.

## **Benefits**

Potential benefits from participation in this study include an increase in knowledge regarding the diagnosis and symptoms of Lyme disease at no financial cost. The potential benefits of the study include a deeper understanding of the design of online CME and the effect of the design elements on physicians' behavior. You will also have the opportunity to receive future information regarding the accredited CME course as well as a raffle opportunity once you have completed the final survey. As a participant you will also be provided a summary of the research results. This will allow you to see how interactive elements affect online CME courses and could influence your choice of course in the future.

## **Confidentiality**

The presentation of this research will take place on JMU campus in Memorial Hall during April 2011. While individual responses are obtained and recorded, the results will be coded and kept in the strictest confidence. Aggregate data will be presented representing averages or generalizations about the responses as a whole. No identifiable information will be presented in the final form of this study. All data will be stored in a secure location accessible only to the researcher. The researcher retains the right to use and publish non-identifiable data. At the end of the study, all data will be destroyed.

## **Participation & Withdrawal**

Your participation is entirely voluntary. You are free to choose not to participate. Should you choose to participate, you can withdraw at any time without consequences of any kind. However, once your responses have been submitted and recorded you will not be able to withdraw from the study.

## **Questions about the Study**

If you have questions or concerns during the time of your participation in this study, or after its completion, or you would like to receive a copy of the final aggregate results of this study, please contact:

### **Monica Blackwell**

Adult Human Resource Development  
James Madison University  
blackwml@dukes.jmu.edu

### **Dr. Diane Wilcox**

Adult Human Resource Development  
James Madison University  
wilcoxdm@jmu.edu

**Questions about Your Rights as a Research Subject**

Dr. David Cockley  
Chair, Institutional Review Board  
James Madison University  
(540) 568-2834  
[cocklede@jmu.edu](mailto:cocklede@jmu.edu)

## Appendix B: Matrices Used In Researcher's Evaluation of Current CME Courses

Matrix used with first evaluation question regarding the Level 2 Evaluation and knowledge gain:

<b>CME Course</b>	<b>Does the course provide a way to assess the learner's current knowledge (prior to course participation) of the presented content?</b>	<b>Does the course provide a way to assess the amount of knowledge gained by the learner after participating in the course?</b>	<b>Does the course provide feedback for the learner on his/her learning?</b>	<b>Are the assessments related to the learner's work environment?</b>
<b>IDSA Course – Lyme Disease</b>	Pre-test before each case study; The answers provided for the questions were taken directly quoted from IDSA guidelines without any further explanation	Post-test (only multiple choice questions) at the end of each case study. Learner had to complete at least 4/6 cases and receive a 70% average on post-tests	Only feedback was answers to pre and post-tests; feedback consisted of excerpts directly quoted from guidelines	All assessments were multiple choice questions which proved learners read and understood guidelines; few questions utilized realistic examples
<b>BMJ Learning Course - Shingles</b>	No pre-test	Post-test at the end; 11 multiple choice questions and did provide answers but standard responses; learner had to score a 70% or more to pass for credit	Only feedback was answers to post test; much of the feedback was the same answer copied and pasted for all answer choices	All assessments were multiple choice questions; some included realistic examples
<b>Medscape Course - HPV</b>	No pre-test	Post test consisted of two multiple choice questions. Even though learner missed one of the questions, placing the score at 50%, it still granted learner CME credit	Only feedback was answers to post test; consisted of brief statement and lacked information on what answer choice selected	All assessments were multiple choice and zero included realistic examples

Matrix used for second evaluation question regarding Gagne's Nine Events of Instruction

(Part I):

<b>CME Course</b>	<b>Does the course gain the attention of the learner?</b>	<b>Does the course provide the learner with objectives?</b>	<b>Does the course stimulate the recall of the learner's prior knowledge?</b>	<b>Does the course present the new content?</b>	<b>Does the course provide any guidance in order to direct the learner through the learning process?</b>
<b>IDSA Course – Lyme Disease</b>	No – as soon as learner registered the cases were presented	Yes – Overall objectives were found at the beginning of the course and before each case study	Yes – with pre-test involving multiple choice questions usually 1-2 questions	The content was presented in smaller chunks. However, all content was presented in the same manner – majority text with a few picture links.	There was a navigation bar within each case to show learner progress.
<b>BMJ Learning Course - Shingles</b>	No – only minor evidence of this would be the author stated the reasoning behind the course	No – did provide key points in the beginning	No	The content is presented using ALL text. The pages were full of paragraph after paragraph. 2 figures were included.	No guidance once module was chosen, it became a linear course
<b>Medscape Course - HPV</b>	No – as soon as learner selected the first video presentation the information began	The overall objectives were presented before beginning course. One of the video presentations provided individual learning objectives.	No	The content was presented well in four individual modules. The slides were helpful with lots of graphics and little text. Also utilized audio and video elements	No guidance once module was chosen, it became a linear course

2<sup>nd</sup> Matrix used for second evaluation question regarding Gagne's Nine Events of

Instruction (Part II):

<b>CME Course</b>	<b>Does the course elicit performance by the learner?</b>	<b>Does the course provide any feedback for the learner?</b>	<b>Does the course assess the performance?</b>	<b>Does the course assist with retention and learning transfer?</b>
<b>IDSA Course – Lyme Disease</b>	Only performance was tested at the end of each case study.	The only feedback was excerpts from the guidelines for each multiple choice question.	In order to get CME credit the learner must complete the post tests with at least a 70%.	No – once learner completed one case study, he/she progressed on to the next case until they have completed at least 4/6 case studies
<b>BMJ Learning Course - Shingles</b>	Only performance question was at the end which was the post-test	The only feedback was the excerpts listed after each answer choice on post-test. However, for some questions the same excerpt was used for all answer choices (right or wrong)	In order to get CME credit the learner must complete the post test with at least a 70%.	No – once learner completed the post-test it provided the references if learner needed further information
<b>Medscape Course - HPV</b>	During the course the learner was asked to participate in a question poll during the fourth module listed. The course also included a multiple choice post-test.	The questions for the polling section listed the percentage of other participants who selected each answer. The post-test had little feedback. It would tell learner the correct answer but did not tell learner what he/she selected and they could not go back to look at the question again.	Even though learner received a 50% on the post test it allowed learner to complete the reaction survey in order to receive CME credit.	No – after post-test the course was over

Matrix used for third evaluation question regarding Universal Design for Learning:

<b>CME Course</b>	<b>Does the course have multiple representations to satisfy multiple learning styles? (text, graphics, audio and video)? (Principle 1)</b>	<b>Does the course provide multiple ways for learners to express their knowledge? (principle 2)</b>	<b>Does the course incorporate opportunities for learners to interact with the course? (principle 2)</b>	<b>Does the course provide accommodations for physically handicapped learners to participate? (principle 2)</b>	<b>Does the course provide realistic situations and examples? (principle 3)</b>	<b>Does the course provide the learner with choices throughout the course? (principle 3)</b>
<b>IDSA Course – Lyme Disease</b>	No – only text with 4-6 pictures for all 6 case studies. The pictures were on a separate page without captions. The pages were 95% text with a few pieces of color.	No – Only way for learners to express themselves was through multiple choice test questions at the beginning and the end.	The only interaction was to click on the “next” or “previous” buttons or to answer the multiple choice tests.	No audio, and no written plan on how physically handicapped could participate.	All examples were case studies which could be similar to what the learners could see in their own practice.	Learners could decide what order to complete the case studies.
<b>BMJ Learning Course - Shingles</b>	No – Tons of text with only 2 figures. Little color. Pages of text began to all look the same after a few pages.	No – Only way for learners to express themselves was through multiple choice test questions at the end.	The only interaction was to click on the “next” or “previous” buttons or to answer the multiple choice tests.	No audio, and no written plan on how physically handicapped could participate.	Did provide few examples of how to handle certain situations but mostly text regarding elements of disease	Course was a linear course – participants did not have any choices
<b>Medscape Course - HPV</b>	The course provided four modules. All had a video of	Learners had the opportunity to	The only interaction was the two multiple	The course did provide audio for the speakers. No	Did provide case studies	You could complete the four video



	<p>speaker talking as well as a slide set that included text, graphics, color, etc. One speaker even used animations to highlight important material.</p>	<p>participate in a post-test (2 multiple choice questions) as well as 2 multiple choice polling questions.</p>	<p>choice sections. However, the polling question did allow the learner to see the percentages of how others answered the polling questions</p>	<p>other physical handicapped accommodated .</p>	<p>and current research.</p>	<p>presentations in any order which gave learners some amount of choice within the course.</p>
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## Appendix C: Pre- and Post-Test Instruments

### Online CME Pre-Test

**Directions:** Please complete the following questions to the best of your ability. Remember, all answers will be kept confidential.

**Case Study:** After reviewing the case study below, answer the questions below:

**History:** 53-year-old woman was referred to an ENT clinic for an evaluation following the sudden onset of a right facial droop accompanied by an occipital headache.

Symptoms began one week ago. She also noted an oval rash on her abdomen which did not itch. She otherwise felt well; she denied fever, chills, photophobia, neck pain or stiffness, myalgia and joint pain or swelling. The patient is a hunter and recalled having had a tick bite two weeks prior to the onset of symptoms.

**Exam:** The patient looked well, except for the facial droop (see figure below). Her vital signs were normal; temperature was 98.3. A salmon colored, oval rash of 7cm was visible on her abdomen, just above the umbilicus. HEENT examination was normal; there were no vesicles. Neurologic exam of the head and neck demonstrated a right facial nerve palsy; the other cranial nerves were normal and she had full range of motion of her neck without pain.



Photo #6633 provided by CDC's Public Health Image Library

1. Place a check mark beside each symptom that is consistent with Lyme disease.
  - a. The rash on the patient's abdomen
  - b. The facial palsy
  - c. The results of her ear and throat examination
  - d. The absence of a fever or neck stiffness
  
2. List, in order from 1-5 the steps you would take in diagnosing this patient.
  - a. Gather history
  - b. Run diagnostic tests
  - c. Confirm diagnosis of Lyme disease/Confirm alternative diagnosis
  - d. Conduct a physical exam of patient
  
3. The rash found on the patient's abdomen is inconsistent with Lyme disease due to the absence of the "bull's-eye" appearance.
  - a. True
  - b. False
  
4. If the patient does in fact have Lyme disease, what stage of Lyme disease would you consider this patient to be in at this point?
  - a. Early Localized Lyme
  - b. Early Disseminated Lyme
  - c. Late Lyme

**General Questions:** Please answer the following questions to the best of your ability.

5. Lyme disease is only found in the Northeastern region of the United States.
  - a. True
  - b. False

6. Less than 14% of patients who have the EM rash actually recall the tick bite which caused the rash.
  - a. True
  - b. False
  
7. Less than 20% of all erythema migrans (EM) rashes have a classic "bull's-eye" appearance.
  - a. True
  - b. False
  
8. In Disseminated Lyme disease, check all of the symptoms that a patient could have.
  - a. EM rash
  - b. Fever
  - c. Poor Memory
  - d. Joint Pain
  - e. Rapid Heartbeat
  - f. Muscle Aches
  - g. Bell's Palsy

## Online CME Post-Test

Welcome to the post-test for the online CME course regarding Lyme disease. Once you have completed this test you only have one more component to go before completing this course!

**Directions:** Please complete the following questions to the best of your ability. Remember, all answers will be kept confidential.

**Case Study:** After reviewing the case study below, answer the questions that follow.

### History:

A 46 year-old woman seeks your opinion after being ill for 2 years; a neuromuscular specialist recently suggested she may have Lyme disease.

Her first symptoms were pain, cramping and fasciculations in the muscles of her hands and feet. The pain was worse with activity and at night; often reaching 8 on a 0-10 pain scale. Anti-inflammatories were not helpful. She has good relief from gabapentin 1200mg three times daily but now has weakness in these same areas and recently began using ankle-foot orthotics.

At disease onset she had 2 -3 weeks of profound fatigue, chills and night sweats (changed clothing 2-3 times each night); symptoms persist but are less prominent. She also had profound fatigue and episodes of tachycardia with a pulse of 180-200 bpm. The tachycardia was brought on by sudden changes in position, especially when she went from a sitting to a standing position. Within 4 months of symptom onset, she had a positive tilt-table and was diagnosed with postural tachycardia syndrome.

Past medical history was positive for a tonsillectomy and appendectomy.

She had no known drug allergies.

Medications: oral contraceptives, gabapentin 1200mg 3x daily, midodrine 10 mg daily, metoprolol XR 50 mg each night, multivitamin and calcium.

Family history is positive for hypertension in her mother; The patient's siblings and two children are in good health.

Social history: She was employed full-time in a professional capacity before her illness but now only works half-time; married for 20 years. Non- smoker; rare alcohol; no recreational drugs use; caffeine limited to 2 cups in the am. She lives in a semi-rural area of PA.

Review of systems: She has cold intolerance. She has episodes of right knee pain she thought were due to osteoarthritis. She is easily distracted and sometimes gets disoriented in familiar places. She word searches and sometimes says the wrong word ("thank you" instead of "bless you"). There is no history of a tick bite or an erythema migrans rash.

Exam:

Physical Examination:

P 76, BP 110/70, RR 14 T 97.2

HEENT exam is normal. She has full range of motion of her neck; there is no cervical

lymphadenopathy. Chest is clear. She has normal heart tones; pulses are full but she has dependent edema. Abdomen is soft and nontender, without masses or organomegaly. Extremity exam demonstrates wasting of intrinsic muscles of her hands and feet; the feet are cool, sweaty and dusky. Neurologic exam demonstrates normal cranial nerves and except for the hands and feet she has normal muscle strength and bulk. She has decreased sensation to temperature, pain and in her hands and feet, with diminished proprioception only in her feet. Coordination, station and gait are normal. Mental status is normal except she made several errors answering simple arithmetic questions.

1. Place a check mark beside each symptom that is consistent with Lyme disease.
  - a. Postural tachycardia syndrome
  - b. Chills and night sweats
  - c. Blood pressure and temperature
  - d. Right knee pain
  - e. Distractability
  - f. Normal cranial nerves
  - g. Pain in the hands and feet
2. List in order from 1-5 the steps you would take in diagnosing this patient.
  - a. Gather history
  - b. Run diagnostic tests
  - c. Confirm diagnosis of Lyme disease/Confirm alternative diagnosis
  - d. Construct differential diagnosis
  - e. Conduct a physical exam of patient
3. Due to the lack of a tick bite or EM rash history, the patient cannot have Lyme disease.
  - a. True
  - b. False
4. If the patient does in fact have Lyme disease, what stage of Lyme disease would you consider this patient to be in at this point?
  - a. Early Localized Lyme
  - b. Early Disseminated Lyme
  - c. Late Lyme

**General Questions:** Please answer the following questions to the best of your ability.

9. Lyme disease is only found in the Northeastern region of the United States.
  - a. True
  - b. False
  
10. Less than 14% of patients who have the EM rash actually recall the tick bite which caused the rash.
  - a. True
  - b. False
  
11. Less than 20% of all erythema migrans (EM) rashes have a classic "bull's-eye" appearance.
  - a. True
  - b. False
  
12. In Disseminated Lyme disease, check all of the symptoms that a patient could have.
  - a. EM rash
  - b. Fever
  - c. Poor Memory
  - d. Joint Pain
  - e. Rapid Heartbeat
  - f. Muscle Aches
  - g. Bell's Palsy



## Appendix D: Final Survey Instrument

### Evaluation of Lyme Disease Continuing Medical Education

Thank you for participating in this study! The following survey will be your final step as a participant and will be used to evaluate the effectiveness of the CME Lyme Disease training. When answering the questions below, please use your experiences from the three week time lapse between the training and now.

As before, all of your answers will remain confidential. It should take you less than 10 minutes to complete the survey. Once again, thank you for your participation in my Thesis research!

1. Did you complete the online CME course regarding Lyme disease?
  - a. Yes
  - b. No (If no, the survey would end)
  
2. Please select your gender.
  - a. Male
  - b. Female
  
3. How old are you?

(This question utilized a slider and the participant will slide the slider until it corresponds with their age. The scale goes from 20-80.)
  
4. Please select the description that describes your medical title.
  - a. Physician
  - b. Physicians Assistant
  - c. Nurse
  - d. Nurse Practitioner
  - e. Other \_\_\_\_\_

5. What is your medical specialty?
  - a. Family Practice
  - b. Emergency Medicine
  - c. Pediatrics
  - d. Internal Medicine
  - e. Nursing
  - f. Other \_\_\_\_\_
  
6. Which of the following best describes your workplace?
  - a. Hospital Based
  - b. An individual practice
  - c. A Small Group Practice
  - d. A Large Group Practice
  - e. Other \_\_\_\_\_
  
7. Which word below describes the region in which you practice medicine?
  - a. Rural
  - b. Urban
  - c. Suburban
  
8. Select all the locations in which you have access to the Internet.
  - a. Examination Rooms
  - b. In my office
  - c. Home
  - d. Other \_\_\_\_\_

9. Based on what you learned from the content of the CME course regarding Lyme disease, how confident are you regarding the following categories?

	<b>Less Confident</b>	<b>Unchanged</b>	<b>More Confident</b>	<b>Very Confident</b>
<b>Making a clinical diagnosis of a patient with Lyme disease.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Identifying symptoms that could be related to Lyme disease.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Recognizing various types of EM rashes.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Understanding the difference between localized and disseminated Lyme disease.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Describing clinical characteristics of Lyme disease to colleagues.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. During the three week period between the completion of the CME course and this survey how often did you perform the following actions:

- \_\_\_ See a patient with an insect/tick bite.
- \_\_\_ Discuss Lyme disease with a patient.
- \_\_\_ Diagnose a patient with Lyme disease.
- \_\_\_ Refer a patient to a Lyme specialist.
- \_\_\_ Refer to the online training module.
- \_\_\_ Refer to the information you gained by completing the online course.
- \_\_\_ Refer to the case studies found in the online training module.
- \_\_\_ Refer to the online Wikispaces<sup>®</sup> discussion blog.
- \_\_\_ Refer to other web-based information regarding Lyme disease.
- \_\_\_ Collaborate with colleagues experienced in diagnosing Lyme disease.

11. Based on what you learned from the Lyme disease course, how would you rate your change in the following behaviors?

	Unchanged	Changed Slightly	Changed Greatly
<b>Discussing Lyme disease with patients.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Recognizing symptoms that could be considered Lyme disease.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Asking additional questions regarding symptoms to consider Lyme disease as a possible diagnosis.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Diagnosing patients with Lyme disease.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Referring patients to Lyme specialists.</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. Did you participate in the case study discussion using Wikispaces<sup>®</sup>?

- a. Yes (if yes, they would then be moved to #13)
- b. No (if no, they would then be moved to #17)

13. Did you post a comment on Wikispaces<sup>®</sup>?

- a. Yes (if yes, they would then be moved to #14)
- b. No (if no, they would then be moved to # 15)

14. How often did you contribute to the online discussion?

- a. 1 time
- b. 2 times
- c. 3 times
- d. 4+ times

15. Please explain why you did not post to the discussion board.

16. Put the following training elements in order from what you found the least helpful (1) to what you found the most helpful (5).

- a. The pre-test
- b. The informational content within the online training module
- c. The interactive questions within the online training module
- d. The online discussion board, Wikispaces<sup>®</sup>
- e. The post-test

17. (The participant would only see this question if they answered “no” to #12): Put the following training elements in order from what you found the least helpful (1) to what you found the most helpful (4).

- a. The pre-test
- b. The informational content within the online training module
- c. The cases found within the online training module
- d. The post-test

By clicking the next button, the survey will be submitted.

## **Appendix E: Consent Form Sent to Interviewees**

### **Identification of Investigators & Purpose of Study**

You have previously participated in a research study regarding an online CME course on the topic of Lyme disease. The purpose of this study is to assess whether the interactive elements included in the CME course promoted retention and transfer in a way that would be portrayed in the behavior of the participants. The current research study will answer the following research question: How can one design online instruction that will foster a change in health care professionals' behavior from the course and into medical practice and increase their self-efficacy with the presented content? This study will contribute to the researcher's completion of her master's thesis. It will also act as a pilot study for future, accredited CME course.

### **Research Procedures**

You are being asked to extend your participation in this research study by participating in an interview with the researcher, Monica Blackwell. The purpose of the interview is to allow you to expand upon the answers you provided in the online survey.

### **Time Required**

The interview should take no longer than 15 minutes of your time.

### **Risks**

The researcher does not perceive more than minimal risks from your involvement in this study. When reporting the interview data, your name will be stripped from the information.

### **Benefits**

Potential benefits from participation in this study include an increase in knowledge regarding the diagnosis and symptoms of Lyme disease at no financial cost. The potential benefits of the study include a deeper understanding of the design of online CME and the effect of the design elements on physicians' behavior. You will also have the opportunity to receive future information regarding the accredited CME course as well as a raffle opportunity once you have completed the final survey. As a participant you will also be provided a summary of the research results. This will allow you to see how interactive elements affect online CME courses and could influence your choice of course in the future.

### **Confidentiality**

The presentation of this research will take place on JMU campus in Memorial Hall during April 2011. While individual responses are obtained and recorded, the results will be coded and kept in the strictest confidence. Aggregate data will be presented representing averages or generalizations about the responses as a whole. No identifiable information will be presented in the final form of this study. All data will be stored in a secure location accessible only to the researcher. The researcher retains the right to use and publish non-identifiable data. At the end of the study, all data will be destroyed.

### **Participation & Withdrawal**

Your participation is entirely voluntary. You are free to choose not to participate. Should you choose to participate, you can withdraw at any time without consequences of any kind. However, once your responses have been submitted and recorded you will not be able to withdraw from the study.

### **Questions about the Study**

If you have questions or concerns during the time of your participation in this study, or after its completion, or you would like to receive a copy of the final aggregate results of this study, please contact:

Monica Blackwell  
Adult Human Resource Development  
James Madison University  
[blackwml@dukes.jmu.edu](mailto:blackwml@dukes.jmu.edu)

Dr. Diane Wilcox  
Adult Human Resource Development  
James Madison University  
[wilcoxdm@jmu.edu](mailto:wilcoxdm@jmu.edu)

### **Questions about Your Rights as a Research Subject**

Dr. David Cockley  
Chair, Institutional Review Board  
James Madison University  
(540) 568-2834  
[cocklede@jmu.edu](mailto:cocklede@jmu.edu)

## Appendix F: Interview Notes

**Name:** Interviewee A

**Date:** Thursday, February 17, 2011

### Interview Questions:

**1. What is your medical title and specialty?**

MD, board certified in pediatrics

**2. Did you complete the online CME course regarding Lyme disease?**

Yes

**3. Based on what you learned from the content of the CME course regarding Lyme disease, how confident are you regarding the following categories?**

**a. Making a clinical diagnosis of a patient with Lyme disease**

Very Comfortable

**b. Identifying symptoms that could be related to Lyme disease**

Very comfortable

**c. Recognizing various types of EM rashes**

Very comfortable – knowledge was enhanced especially in this area

**d. Understanding the difference between localized and disseminated Lyme disease**

Very comfortable – knowledge was enhanced; he is now more informed about the stages and how the body systems fit into the overall pattern

**e. Describing clinical characteristics of Lyme disease to colleagues**

Course improved his knowledge; This is still a little difficult because the disease is not one of the everyday things they deal with. He felt like the more you do it the more comfortable it will become.



**4. Based on what you learned from the Lyme disease CME course, how did your behavior change in the following behaviors:**

**a. Discussing Lyme disease with patients**

Behavior changed in the following ways:

- Lyme disease passes through his mind more often especially with the joint systems because they are not “classic” symptoms
- He has ordered the test a few extra times since the course

**b. Recognizing symptoms that could be considered Lyme disease**

Behavior has changed – There was a very complete list of symptoms in the course so it definitely enhanced his knowledge. He had a Bell’s Palsy patient last week and he ordered a test.

**c. Asking additional questions regarding symptoms to consider Lyme disease as a possible diagnosis**

Behavior has changed – he asks more questions regarding a patient’s social life (Have they been in the woods, gone camping, visited specific parts of the country, etc.)

**d. Diagnosing patients with Lyme disease**

His behavior has changed in the way of ordering tests more often but he has yet to have a positive test result.

**e. Referring patients to Lyme specialists**

His behavior has not changed since the course but he has referred patients in the past.

**5. Did you have the opportunity to participate in the case study discussion using Wikispaces?**

No

**6. If so, did you participate in the discussion? Why or why not?**

NA

**7. Regarding the online CME course training elements (post-test, content, interactive questions, etc.), what did you find the most helpful? Why?**

It was an excellent refresher! The course content in itself was the most helpful, especially the breadth of the different stages and its overall comprehensive nature. He also enjoyed the realistic pictures of the EM rashes. It was a good way to produce a mental image.

**8. Regarding the online CME course training elements, what did you find the least helpful? Why?**

The pre-test was the least helpful because he wanted to jump right into the content. He is ok with producing proof of learning at the end but he doesn't like to show what he didn't know in the beginning.

**9. What elements within the course would you like to see in future CME courses?**

He would like to see future CME courses with more videos with realistic situations. He would also like to see more 1-1 situations with the instructor guiding the learning.

**Additional comments:** none

**Name:** Interviewee B

**Date:** Thursday, February 17, 2011

**Interview Questions:**

1. **What is your medical title and specialty?**  
MD, board certified in family practice
  
2. **Did you complete the online CME course regarding Lyme disease?**  
Yes
  
3. **Based on what you learned from the content of the CME course regarding Lyme disease, how confident are you regarding the following categories?**
  - a. **Making a clinical diagnosis of a patient with Lyme disease**  
Pretty confident
  
  - b. **Identifying symptoms that could be related to Lyme disease**  
Very confident
  
  - c. **Recognizing various types of EM rashes**  
Very confident
  
  - d. **Understanding the difference between localized and disseminated Lyme disease**  
Confident
  
  - e. **Describing clinical characteristics of Lyme disease to colleagues**  
Very confident – She has had many discussions about it
  
4. **Based on what you learned from the Lyme disease CME course, how did your behavior change in the following behaviors:**
  - a. **Discussing Lyme disease with patients**  
Her behavior has remained the same. She was already doing this pretty often before taking the course.
  
  - b. **Recognizing symptoms that could be considered Lyme disease**  
There were a few symptoms that Interviewee B learned about using the course content.
  
  - c. **Asking additional questions regarding symptoms to consider Lyme disease as a possible diagnosis**  
Her behavior did not change because she was already asking all these questions

**d. Diagnosing patients with Lyme disease**

Her behavior did not change because she was already diagnosing patients.

**e. Referring patients to Lyme specialists**

Her behavior did not change. She is already trained to properly diagnose and treat patients with Lyme disease.

**5. Did you have the opportunity to participate in the case study discussion using Wikispaces?**

Interviewee B looked at the site but had problems connecting to the Internet during the time she was completing the course.

**6. If so, did you participate in the discussion? Why or why not?**

NA

**7. Regarding the online CME course training elements (post-test, content, interactive questions, etc.), what did you find the most helpful? Why?**

Interviewee B found the content regarding the symptoms and differences in the stages helpful because these were the things she did not already know.

**8. Regarding the online CME course training elements, what did you find the least helpful? Why?**

Interviewee B felt the post-test need to be more comprehensive. She also felt dissatisfied with the two tests due to the lack of feedback provided at the end of each test.

**9. What elements within the course would you like to see in future CME courses?**

Interviewee B wished the content had not been broken up and wanted less choice of the order in which to view the content. The section in which she had to choose the section, she found it difficult to follow and remember which sections she had already completed. It also broke her concentration by having to flip between sections.

**Additional comments:**

Overall, it was good and pretty smooth. Interviewee B felt that the survey needed to be separated more according to the level of training participants had with Lyme disease (someone who is new to the content vs. someone who is trained in Lyme disease). Another suggestion was to restrict participation to only those who are new to the topic of Lyme disease. It was difficult for her to decide whether her behavior had changed because there was no option of “I was participating in these behaviors previously.” She suggested using a scale from 1-10 in the future.

She also found the audio recording to be very distracting. There were words that were mispronounced.

Interviewee B had a few technical problems within the course and found it frustrating that the course took a long time to load.

**Name:** Interviewee C

**Date:** Wednesday, February 23, 2011

**Interview Questions:**

1. **What is your medical title and specialty?**  
 Medical Student First Year  
 Interested in Emergency medicine and family practitioner
2. **Did you complete the online CME course regarding Lyme disease?**  
 Yes
3. **Based on what you learned from the content of the CME course regarding Lyme disease, how confident are you regarding the following categories?**
  - a. **Making a clinical diagnosis of a patient with Lyme disease**  
 More confident after watching the course
  - b. **Identifying symptoms that could be related to Lyme disease**  
 Definitely more confident
  - c. **Recognizing various types of EM rashes**  
 He can't quantify because he doesn't remember this part of the course
  - d. **Understanding the difference between localized and disseminated Lyme disease**  
 He understands this more after watching the course; beforehand he didn't know there were differences
  - e. **Describing clinical characteristics of Lyme disease to colleagues**  
 The course gave you a better understanding and vocabulary to help convince or speak to other partners about making that diagnosis
4. **Based on what you learned from the Lyme disease CME course, how did your behavior change in the following behaviors:**
  - a. **Discussing Lyme disease with patients**  
 By knowing the different symptoms it would make him more confident in speaking with patients. By taking the course and finding more about the disease it will help you speak to patients, recognize the symptoms, and help the patient pursue the right type of treatment

**b. Recognizing symptoms that could be considered Lyme disease**

Yes absolutely it changed

**c. Asking additional questions regarding symptoms to consider Lyme disease as a possible diagnosis**

Now that he knows the symptoms to look for he would pursue those to help rule in or rule out Lyme disease – by taking this course he learned some new skills and things to look for and the right questions to ask to lead to that diagnosis

**d. Diagnosing patients with Lyme disease**

Same as above

**e. Referring patients to Lyme specialists**

He would definitely be able to recognize the disease and help people find doctors that specialize in the disease...essentially this behavior has improved.

**5. Did you have the opportunity to participate in the case study discussion using Wikispaces?**

Yes

**6. If so, did you participate in the discussion? Why or why not?**

Yes – He posted on the discussion board. However, after posting, he misplaced the web address. It would have been nice to have received an email saying “Thanks for posting and check back to see others’ posts.” Then he would have been able to go back and see how others responded.

**7. Regarding the online CME course training elements (post-test, content, interactive questions, etc.), what did you find the most helpful? Why?**

Questions that were asked after each section – checking understanding to see if you are following along and catching the main points

**8. Regarding the online CME course training elements, what did you find the least helpful? Why?**

He couldn't quantify what was the least helpful

**9. What elements within the course would you like to see in future CME courses?**

He would like to see a section with relevant journal articles; It is a great thing to add because physicians really like facts and figures and if it has been in a journal, then that is golden to a doctor.



**Name:** Interviewee D

**Date:** Wednesday, March 02, 2011

**Interview Questions:**

1. **What is your medical title and specialty?**  
Nursing Student; In the future she may want to work in pediatrics
2. **Did you complete the online CME course regarding Lyme disease?**  
Yes
3. **Based on what you learned from the content of the CME course regarding Lyme disease, how confident are you regarding the following categories?**
  - a. **Making a clinical diagnosis of a patient with Lyme disease**  
Pretty confident ; She also has had Lyme disease so she was already pretty familiar with content
  - b. **Identifying symptoms that could be related to Lyme disease**  
Confident
  - c. **Recognizing various types of EM rashes**  
She would have a little difficulty with this because they can all be very different. Certain ones she is very confident in recognizing
  - d. **Understanding the difference between localized and disseminated Lyme disease**  
Confident
  - e. **Describing clinical characteristics of Lyme disease to colleagues**  
Confident – She may not cover everything but this is something that she could do
4. **Based on what you learned from the Lyme disease CME course, how did your behavior change in the following behaviors:**
  - a. **Discussing Lyme disease with patients**  
Not working with patients currently
  - b. **Recognizing symptoms that could be considered Lyme disease**  
Not working with patients currently

**c. Asking additional questions regarding symptoms to consider Lyme disease as a possible diagnosis**

Not working with patients currently

**d. Diagnosing patients with Lyme disease**

Not working with patients currently

**e. Referring patients to Lyme specialists**

Not working with patients currently

**5. Did you have the opportunity to participate in the case study discussion using Wikispaces?**

Yes

**6. If so, did you participate in the discussion? Why or why not?**

No because she was running short on time

**7. Regarding the online CME course training elements (post-test, content, interactive questions, etc.), what did you find the most helpful? Why?**

The content about symptoms was the most helpful

**8. Regarding the online CME course training elements, what did you find the least helpful? Why?**

If she had to decide she would say the pre-test. However, it was helpful in the end after seeing the differences and what she had learned.

**9. What elements within the course would you like to see in future CME courses?**

The content was very helpful. The interactive questions were helpful. The Post test is not necessary but it does help.

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